THE

ELECTRICAL REVIEW.

VOL. LXI. OCTOBER 18, 1907. No. 1,560.

ELECTRICAL REVIEW.

Vol. LXI.] CONTENTS: October 18, 1907. [No. 1,560.

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THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

1907 EDITION.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. *Established 1872.*
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone Nos. Holborn 988; Central 4425 (Editorial only).
ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

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THE POSITION OF THE LARGE GAS ENGINE.

As we briefly mentioned in our last issue, a party of engineers last week visited a number of installations on the Continent, for the purpose of seeing for themselves how far the reports of German successes with large gas engines were justified. It might be thought that such an expedition was superfluous; that the feasibility of constructing gas engines of 1,000 H.P. and upwards, and the much more difficult feat of ensuring their running without breakdown or other serious mishap when constructed, had been amply demonstrated during the past few years, and that there could be nothing new to learn on a subject that had been discussed to death, so to speak. We believe, however, that those who took part in the four days' tour will cordially agree with us in the contrary view.

To read about an engineering achievement is one thing; to see a 2,000-H.P. engine driving a direct-coupled generator is quite another, and a vastly more impressive sensation. Credit is due to the organisers of the visit—the Key Engineering Co.—and their collaborators, Messrs. Ehrhardt & Sehmer, for their energy and enterprise in this matter. It was unfortunate, perhaps, that all the engines inspected were driven with blast-furnace or coke-oven gases, and none with producer gas; we doubt, however, whether any large examples of the last-named type are to be met with on the Continent, and perhaps from this fact, combined with the unhappy experience at Johannesburg, a lesson may be drawn.

On the other hand, that there is abundant scope for the extended application of large engines driven by blast-furnace gas in this country is a fact familiar to our readers; from time to time we have emphasised the importance of this field for development, and, indeed, we have published more than 30 articles on the subject since the practical utilisation of blast-furnace gases for the generation of power, originated by Mr. B. H. Thwaite, became an accomplished fact. We regret, however, that the apathy of British iron manufacturers, on which we have so often commented, remains apparently impregnable. It is true that a very few instances exist in which this originally British idea has been applied in this country; at Sir Alfred Hickman's works, for instance, a large number of steam engines have been replaced by electric motors supplied with power from blast-furnace gas engines, with a resultant saving of seven or eight thousand pounds a year; at Cargo Fleet also, the furnace gases are being used for power generation on a large scale. There is hope, therefore, that with actual examples under their noses, our compatriots will be compelled to realise the importance of the matter, while there is no doubt that the next period of depression in the iron trade will drive home the argument in the most forcible and painful manner possible.

An output of 1,000 tons of pig-iron per week implies a

horse-power continuously available—after providing for the hot-blast stoves and blowing-engines—of about 5,000 H.P. As the output of the furnaces in this country is about 200,000 tons a week, it follows that about one million horse-power could be obtained from this source for general use. As a matter of fact, it is doubtful whether one-fiftieth part of this is at present generated in gas engines, which require only one-fourth or one-fifth of the amount of gas that must be burnt under boilers to produce the same amount of power. On the Continent, on the other hand, a quarter of a million horse-power is generated with blast-furnace gas engines, the cost in some cases being as low as 0·2d. per KW.-hour. We were informed last week that electrical energy derived from this source was supplied in parts of Alsace-Lorraine to distributors in bulk at 0·25d. per unit, and sold to ordinary users for lighting and power at 0·375d. We take no responsibility for these figures, which await confirmation; obviously they would be impossible with underground mains. But with overhead mains and blast-furnace gas power the same result can equally well be achieved here. Why do the ironmasters close their eyes to this invaluable source of revenue?

The saving in fuel used in the works is itself of no small value. In an important paper read recently before the Deutscher Eisen und Stahlwerks Verband, it was shown that a saving of nearly 5,000 tons of coal per month for the generation of power was effected by the substitution of gas for steam, while the output of pig-iron was increased from 21,400 to 30,000 tons per month. The cash value of the saving was £75,000 per annum. We give elsewhere in this issue further particulars relating to this remarkable result, which surely is worthy of the attention of British ironmasters. The pressure on our space forbids further reference to the subject at the moment, but in a future issue we shall describe and illustrate some of the fine machinery that we inspected last week.

Lindal Moor Electrical Pumping Plant.

In another part of this issue we publish a very exhaustive description of the extensive electrical pumping plant recently erected at Lindal Moor, for unwatering the hematite iron mines held by Harrison, Ainslie & Co. On the occasion of our visit, the inauguration ceremony was performed by Lord Muncaster, who is one of the lords of the manor of the mining area worked by the company, and the guests afterwards inspected the power house, the Bercune, Lowfield and Diamond Mines, during a walk of two hours' duration through rough country, which was as exhilarating as a round over an 18-hole golf course. At the luncheon, over which Sir Owen R. Slacke, C.B., presided, Lord Muncaster gave the toast of "Health and Prosperity to Harrison, Ainslie & Co.," and in returning thanks on behalf of the company, the chairman remarked that, although they were fully alive to the benefits that the country would derive from the works established and carried on by Harrison, Ainslie & Co., they did not pretend that it had been done from philanthropic motives alone. Their object as a company must first be to return a sufficient reward to those who had invested money in it; he was satisfied that they had a great profit-making business. They believed, as directors, that the prospects of Harrison, Ainslie & Co. were good, and that it had a great future.

The consulting engineer, Mr. Ward, who proposed "Our Guests," dilated on the vast difference between the old and new pumping arrangements, which latter, he said, gave English mining engineers an indication of what electricity could do for them. Those who knew what the past had been would be able to agree with him that in all probability a glorious future was in store.

Mr. Frank Dodd, in responding, believed prosperity had dawned, which would rival any times in the past.

Dr. Herzfeld, of the Electrical Co., proposed the toast of the Press, to which a representative of the ELECTRICAL REVIEW briefly replied.

The people of the district are naturally hopeful that the optimistic belief of the directors will be realised, because success will not only mean better trade for the neighbourhood, but it will also give a new lease of life to the iron and steel industries, as, unfortunately, for some time past there has been a decadence of activity in the iron ore business.

We re-echo the wish of the local Press that the fullest success may attend the new scheme.

Mercury Vapour Lamps for Office Use.

We were recently present in an office in which all the business of a considerable establishment was transacted. At one end of the room were draughtsmen, further on the clerical staff, and then the typists and other girl assistants. Mercury vapour lamps were tried at one end of the room, and a good deal of eye irritation disappeared, and finally they were put throughout the room except only at the end where the girls worked. Here they were not placed, this being done out of good natured deference to the supposed feminine antagonism to anything so horrible as the green light for complexions. However, before many days had elapsed, the whole feminine staff petitioned for the new light, and it was made universal throughout the room. Especially in the case of one man who was greatly troubled with irritable eyes, was the change noticed to be good. Where previously he had frequently to stop working and press his eyes or rub them, it was noticed that he quite ceased to do this, showing that the removal of red rays had removed the probable cause of irritation.

The experiment had apparently got beyond experiment, and everyone was satisfied as to the excellence of the new light.

It is sometimes argued that the human eye being brought up on daylight must surely have been evolved on lines to render daylight best for the eye. But there appears to be some reason to doubt this, and to consider that the elimination of red rays might even improve daylight so far as regards its physiological effects, though no one would pretend to say that anything but daylight could render the colouring of nature so beautifully. It may be said that a man in a room is under non-natural conditions, and, therefore, that in a room it may, perhaps, be possible to have a light better fitted to the eye than the sort of daylight that gets into a room. Evidently mercury-vapour green light has some advantages as an artificial light for indoor use, and that the colour is not an insuperable objection seems to be well shown by the feminine petition in its favour to which we have now given publicity.

The subject has, perhaps, hardly received the amount of experimental research to which it is entitled. It is certainly an important matter for the drawing office and the commercial office, for the present systems of artificial lighting are all of an irritant order, and eyes are being seriously damaged. If the mercury light is so easy as it appears to be, it ought certainly to be used in evening schools. Thousands of children leave school with permanently damaged eyesight who might probably be saved from such an evil.

Power Tests for Prospective Customers.

The completion of the first 12,500 H.P. installation of the Minneapolis General Electric Co., at Taylor's Falls, Minnesota, placed that organisation in a position to supply many large consumers with energy, particularly on long-term contracts. Upon the introduction of this power into Minneapolis, a thorough canvass was made of the manufacturing districts, the agents being careful to get all the information possible as to horse-power, hours of operation, and general character of work done by individual firms. This information was then worked up into a classified form, and maps were made showing the exact situation of the different plants, and the company's existing and proposed power lines. Letters were then sent to the different firms on the company's lines, requesting them to allow the company to make tests of their engines and apparatus without cost to them, with a view of being able to serve them with electric power at a cost less than their present equipment. This resulted in securing many long-term wholesale power consumers, and brought to light many prospects.

The plan of procedure is followed in making these tests, after permission has been obtained, and which, by the way, is not novel in this country, is to first make a complete sketch of the building, showing the location of all machinery, giving number, size, kind and use of all machines, showing the shafting connections, number of bearings and size of each shafting. After these data have been collected, the next step is to test all engines by means of the indicator, taking cards at intervals of about 15 minutes for the full number of hours the plant is operated per day, also obtaining at some convenient time the maximum load of the plant with all machines running at full load, and then the maximum friction load of the plant with all machines running empty, also the friction load of line shafting alone. If possible, the larger machines are tested individually, while the rest of the plant is shut down. By selecting the important power-consuming machines in this manner, it can be shown just where motors are needed to cut down the friction.

In cases where the plants are operated 24 hours per day, it is necessary to make the full run to get at the actual working conditions. This necessitates enough men to handle the test for the entire day and night. It is also essential that at the time of starting the test the amount of water in the boiler should be noted and the condition of the fire, so that at the end of the run these can be left as nearly as possible in their original condition. During the test all coal consumed is weighed, and all evaporated water noted. Thus the central station company gets at the actual working efficiency of the entire plant, and shows the prospective customer where a saving can be effected through electric power. The company has found that the time these tests take is well expended, as they enable it to become intimately familiar with the actual working facts of the customer's installation.

Belfast.—At the Tramways Committee meeting on the 14th inst., Mr. Nance, manager, presented his half-yearly financial report. From this it appeared there was a working profit on the tramway system of £48,114 15s., notwithstanding the very bad summer, which discouraged tourists and outdoor traffic, and the disturbances in the city. The receipts showed the very satisfactory increase of £6,460, an additional quarter of a million car-miles had been run without additional expense, and the working expense was the very low one of 4·29d. per car-mile, the lowest figure yet reached by any corporation. With regard to the purchase of the Cavehill tramway system, it was decided to confine the financial powers of the Bill to be brought before Parliament to £60,000.

Leith.—A conference took place last week between the Edinburgh Tramway Committee and representatives of the Leith Corporation in reference to the proposed extensions of the tramway system on the boundary of the burgh and city, which was referred to in an earlier issue. The Tramways Committee expressed the view that the city had no particular interest in the proposed extensions to Portobello and Davidson's Mains, but it promised to give careful consideration to the Granton extension, a third of which, representing a cost of some £12,000, would lie in the city area.

SOME INTERESTING EXHIBITS AT OLYMPIA.

Although this Exhibition is now drawing to a close, some further reference to its special features may not be out of place.

An interesting plant in the shape of an electrically-driven three-throw pump with a variable delivery, is shown by Messrs. Thwaites Bros., Ltd., of Vulcan Iron Works, Bradford.

In design the pump and valve bodies do not differ materially from the ordinary, the suction and delivery valves being fitted into valve boxes on one side of the pump barrels. From beneath each suction valve, however, a spindle projects downward through the valve-box casting, and terminates in a small roller end. Under the latter, a horizontal cam shaft, carrying three cams, rotates, being driven direct from the crank shaft through a train of bevel gears.

The angularity of the cams can be varied in relation to that of the crank pins by means of a worm adjustment and hand wheel, whether the pump is running or standing, and this allows of the suction valves being held open during the whole or any required portion of the stroke of the plungers. By this means the delivery can be varied from nothing to full capacity; the power absorbed being in proportion to the quantity of water delivered, as any water not delivered passes back through the suction valves at no pressure.

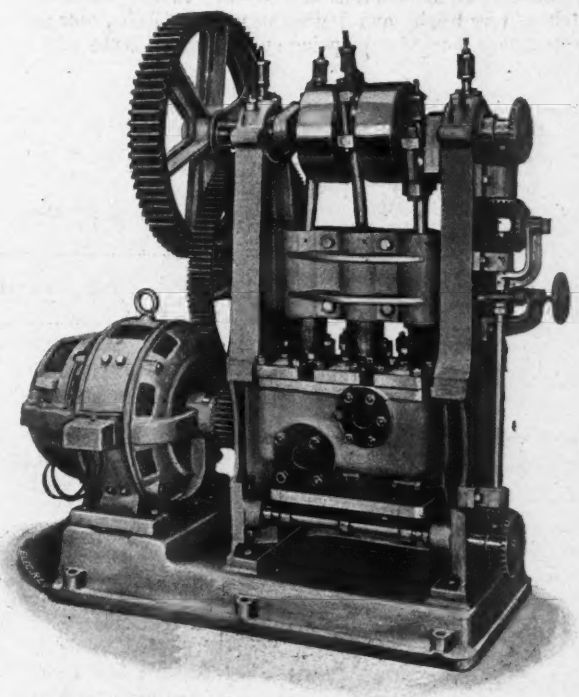


Fig. 1.—Thwaites Variable Delivery Three-Throw Pump.

The arrangement is a simple one, and is illustrated above.

Included amongst the excellent selections of indicators, valves, recorders, &c., shown by the Crosby Steam Gage and Valve Co., of 147, Queen Victoria Street, E.C., to which attention may be drawn, are several examples of the Mason pressure control-appliances, of the spring and lever types, for automatically regulating air, water and steam pumps, and for maintaining any desired pressure.

One of the horizontal pattern devices of this type is specially suited for controlling electrically-driven pumps. Its design and operation are simple; it consists merely of a lever-weighted valve, the valve being a rubber diaphragm, which deflects upwards when the pressure on its underside overcomes the weighted-lever system. Controlled from the lever is a small pilot valve, which regulates the action of the piston in an operating cylinder, admitting pressure

water. The piston, piston rod, &c., is coupled to a rheostat, a compensating device being provided to ensure a step-by-step motion and give a graduated movement.

Other devices equally interesting to the engineer are the Mason steam pump speed governor, an annular Pop safety valve, fitted with a spherical valve, and the new Crosby indicator with external spring and patent reducing wheel and detent.

The latter device appears to represent the acme of indicator construction; the external spring is an obvious advantage; the reducing wheel, with interchangeable pulleys, enables the indicator gear to be readily adapted to any length of stroke—the pulley driving direct from the crosshead, while the detent clutch gear controls the rotation of the barrel.

Messrs. E. A. Brandon & Co., of 33, Devonshire Chambers Bishopsgate, E.C., are exhibiting the Sherardising process of coating articles with zinc. The articles are placed in a closed vessel and packed with zinc dust, the whole being heated to a temperature considerably below the melting point of zinc, the result being that a coating of zinc is formed on the articles, which is very difficult to strip, and is perfectly rust proof, very smooth and even. The process has already been described in our columns.

Sherardised articles that have been previously buffed will take a very bright and lasting polish; and bolts, nuts and screws do not require retapping or screwing, as is the case in hot galvanising, the threads being perfectly smooth.

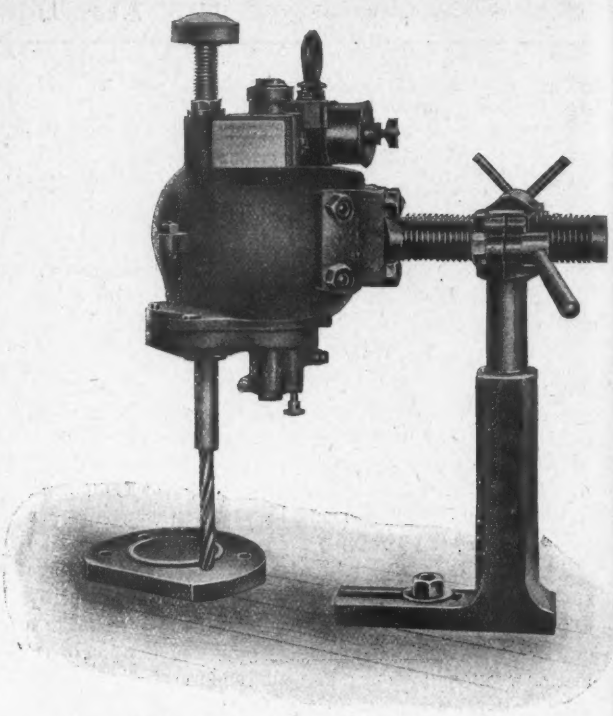


Fig. 3.—Clarke, Chapman Electric Drill.

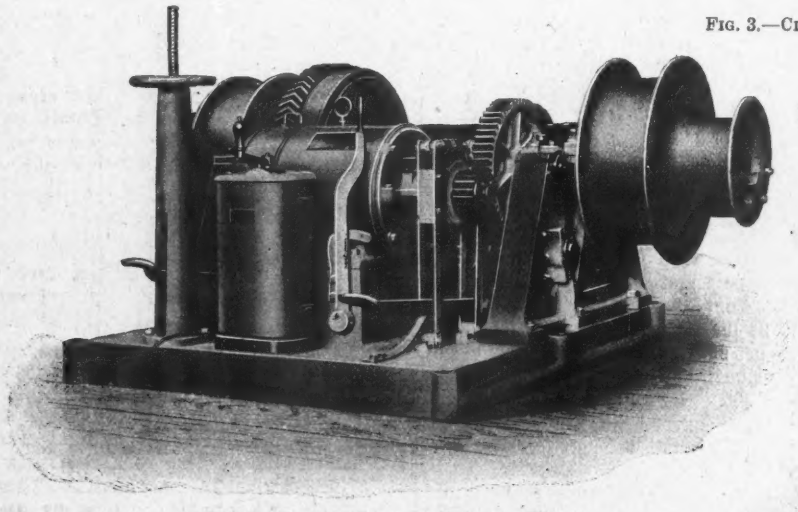


Fig. 2.—Clarke, Chapman Shipyard Winch.

Messrs. Clarke, Chapman and Co., Ltd., of Victoria Works, Gateshead, show a diversity of plant, including capstans, winches, pumps, high speed generating plants, the Woodeson patent water-tube boiler, &c. Fig. 2 illustrates a winch designed for shipyard use, and arranged with the motor driving the barrel and warp ends through three sets of spur gear. The barrel is loose on the shaft and fitted with a clutch for throwing it into gear. It is provided with a foot brake fitted with a screw, which allows of a load being held suspended from the barrel while the warping drums are being used, a foot brake on the motor pinion controlling the latter.

Three warp ends are provided with two diameters, the small

Messrs. Collet & Engelhard, of Offenbach-Main, show a neat electrically-driven travelling drilling and tapping machine, in which the drill mechanism slides along a vertical pillar, which latter can be traversed on a horizontal bedplate supported on four travelling wheels.

The drilling spindle is driven by an electric motor of 2 H.P., through the agency of a double threaded worm gear and spur wheels, which give four different drilling speeds. The drill head can be rotated round the pillar and in a vertical plane; the weight of the machine renders it stable enough for most operations, and arms extending from the base give greater stability if required.

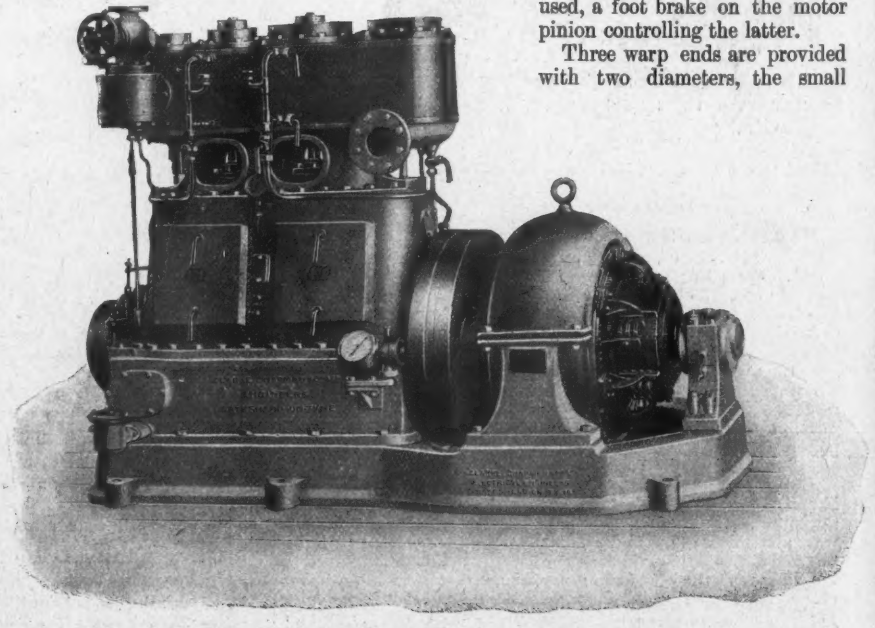


Fig. 4.—High Speed Generating Plant, Clarke, Chapman & Co.

end giving a speed of 40 ft. per min. with 3 tons and the large end 80 ft. per min. with 1½ tons.

The motor is of 12 H.P., and as it is series-wound, light loads can be lifted at high speeds. The resistance and a tramway type reversing controller are mounted on the bed-plate, making the winch self-contained.

A neat electrically-driven baggage winch is also on view; the motor in this case runs continuously and drives the barrel, which is loose on the shaft, through a friction cone. The releasing of the clutch lever automatically brakes the barrel.

Fig. 3 illustrates a compact little electric drill operated by a small enclosed two-pole motor, mounted on the end of an adjustable arm.

As will be gathered from our view, the arm can be screwed through the top of the drill post to adjust the position of the drill head, and the latter can be swivelled to allow the drill to work in any position.

The device is arranged for bolting to the work or to a table; it is provided with two-speed gearing, and the motor being series wound, give a good range of speed.

Fig. 4 shows a high speed generating set, of familiar type, exhibited on the stand.

The governor acts on the throttle, and the lubrication is automatic. The generator is a six-polar direct-current machine, giving 350 amperes at 100 volts pressure, with the engine under steam of 100 lb. pressure, and exhausting to atmosphere. A single cylinder open-type high-speed direct-coupled steam generating set is also on view.

The Heatly-Gresham Engineering Co., Ltd., of Letchworth, Herts, exhibit several of their "Rational" high-speed oil engines, which are suited to a diversity of applications, such as for irrigation and deep-well pumping, general agricultural work and electrical driving.

For small electric lighting work, the "Rational" country house electric lighting sets have been designed; fig. 5 shows a set capable of lighting a house containing 900 lights, other sizes down to 40 lights are made. The engine is direct coupled to the dynamo through a flexible coupling, and mounted on a combination base, forming a self-contained

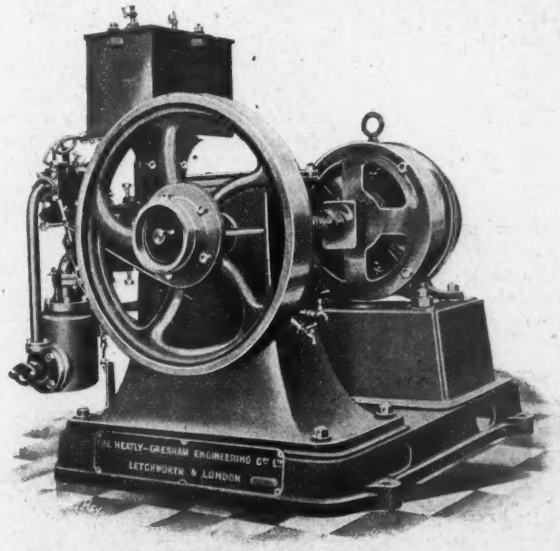


Fig. 5.—Heatly-Gresham House Lighting Plant.

unit, the only external connection being to the cooling water tank and to the switchboard. So compact are these sets that the engine and dynamo to light a house containing 150 lights, only occupies 3 ft. × 4 ft. ground space.

Electric ignition is fitted, and the vaporiser is heated automatically by the exhaust.

The fuel, which is common paraffin, is carried in a large tank above the engine, which consumes only ¾ pint per B.H.P. per hour. The lubrication is entirely automatic, the moving parts are enclosed, and a sensitive governor is fitted. While ordinarily the house is lighted from the storage battery, the switchboard is arranged for direct lighting from the dynamo, which the steadiness of the engine speed renders possible. The engines are balanced, and will run perfectly steadily without any holding down bolts.

They are made in sizes of 2, 3, 6 and 12 B.H.P., and have speeds of 400 R.P.M. for the smallest and 600 R.P.M. for the other sizes.

Messrs. Ludw. Loewe & Co.'s specialities in machine tools and small gauges are fairly well known to our readers. As of more or less electrical interest, we draw attention to the series of small electric drills shown on their stand, and designed to drill holes varying from ¼ in. to 1¼ in. diameter in steel.

These tools are of solid design, with aluminium casings and series-wound motors. Gear box attachments can be added, having a speed ratio of 4 to 1, for slow speed drilling, and drill pillars of the magnetic and ordinary bolted type are supplied when required for holding the tools.

"Standard" grinding attachments and portable drilling equipments (the motor being mounted on wheels and connected to the drill by flexible shafting) are also included. A series of cast-iron resistance grids are shown by this firm, the metal being a specially ductile mixture suited for the purpose.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Testing the Insulation of D.C. Networks.

I have read with interest Mr. Daniel Shirt's article in your issue of October 11th, and thank him for his appreciative remarks on the descriptions in my book of the various ways of testing the insulation of live networks. If he has obtained good results with the method he has mentioned, he is giving me an additional testimonial, for it is virtually the "Method 3" set forth on pages 43 and 48 of the second edition of the book in question. The only difference is that I suggest, as the most convenient method of changing the resistance of the ammeter circuit, to shunt this by a resistance equal to that of the original ammeter circuit. Thus the resistance R_2 in Mr. Shirt's formula (1) is in my case half his R_1; and his current C_2 is in my case twice the second reading of the ammeter, say 2 D_2. On substituting these values in his formula, $\frac{C_2 R_2 - C_1 R_1}{C_1 - C_2}$, it becomes—

$$\frac{2 D_2 \frac{R_1}{2} - C_1 R_1}{C_1 - 2 D_2} = \frac{D_2 - C_1}{C_1 - 2 D_2} R_1;$$

or, multiplying top and bottom by (— 1)—

$$\frac{C_1 - D_2}{2 D_2 - C_1} R_1,$$

which is the same as formula (17) on page 43 of my book.

May I be pardoned for concluding with the following aphorism of one of the minor philosophers: "The spread of knowledge is assisted by surveying the truth at different angles."

F. Charles Raphael.

London, E.C., *October 14th*, 1907.

Differential Radial Axles.

Judging by Mr. Mozley's letter published in your issue of October 11th, Mr. Mozley is under the impression that the idea which is being experimented upon with the Simpson and Park truck on the Burnley Corporation Tramways, namely, the combination with a radial truck of differential driving, is distinctly novel. That this is far from being the case may be seen by reference to the specification of

R. L. McLaren, published in 1892, and referred to at that time in the technical Press.

Those of your readers who are interested in this subject will find by reference to this specification No. 20,672 of 1892, that not only did Mr. McLaren construct radial trucks with differential drive, but he also equipped electric motors on radial trucks; and for this alone it is now impossible for anyone to attempt to establish a master claim, either on electrically-propelled radial trucks, or the same with a differential drive.

I do not wish to interfere between Mr. Mozley and Mr. Acland, but I regard this specification as likely to be not only of interest to your readers, but of considerable importance, since the knowledge that certain attempts have proved a failure may often save a good deal of futile experimenting.

J. Sutherland Warner.

London, S.W., *October* 14*th*, 1907.

Municipal Tramway Conference.

Mr. Acland in his paper on the subject of "Long Wheel-Base Trucks," read before the members of the Municipal Tramways Association, at Manchester, states that with the Warner non-parallel axle truck, the wear of the flanges may probably be less, but that the diametrical wear of the wheel will be increased.

How it is possible to increase the diametrical wear of the wheel without increasing the flange wear Mr. Acland does not tell us. We could understand the flange wear being increased, without increasing the diametrical wear, but not the reverse.

At first I was rather puzzled to know what authority Mr. Acland had for stating that the diametrical wear with my truck would be increased, instead of decreased, as we have always claimed for it. I now learn that this is the opinion at Nuremburg; in fact, I rather think that Mr. Acland himself implies that it is German opinion he has given.

There should be no difficulty in ascertaining the precise facts as to the Warner truck, and there is no reason why any statements which are supported by mere casual surmise should be made concerning this, when precise and unanswerable facts are available, at least to any municipal tramway manager.

The first truck equipped under my patents was on the West Ham Corporation Tramways, where the arrangement has been running for about two years. During the past few days I have examined the tires on the wheels of this car, and the authorities have promised me a set of plaster casts from them. The flanges are as Mr. Acland expects they would be—exceptionally regular, in spite of the fact that the identical tires were in use for about nine months before the car was converted, and about two years with the Warner suspension.

In view of Mr. Acland's remarks at the Conference, I have approached the tramway authorities of the West Ham Corporation, pointing out the desirability of some statement of fact for the guidance of others, and in justice to the particular truck.

I am informed by Mr. H. E. Blain, the general manager, who has had a longer experience of this non-parallel axle truck than anyone else, that not only does he not find the wear of the wheels excessive, but that it is less than with any other type of truck on their system. The excellent riding and absence of vibration are also most marked.

For about twelve months Mr. Blain ran a car on which only one end was fitted under the Warner patents, when by measurement the wheels at the end not fitted with the Warner patent had worn $\frac{5}{16}$ in. smaller in diameter, the tires being steel, and the conditions, of course, identical.

I think if Mr. Acland had called a few days later at Nuremburg, he would have found that the German engineers there had in the meantime learned from a friend of mine what they never knew before, namely, the principle of the "conformity line" (die gleichförmige Linie), on which the whole design and action of the Warner truck is based—and that, understanding the "conformity line," they at once comprehend the reason for the economy of the Warner truck, and no longer maintain that "the grinding action on the rail-head would be greater," &c.

Whatever doubts may exist in some quarters as to the technical or commercial prospects of the Warner truck, there can exist no two opinions as to the principles of the "conformity line," and as to the established unassailable position which this method of considering rolling stock problems has already assumed in traction engineering.

I think I may fairly claim that if, in my destructive criticism of existing car-builders, I have accused them of making cars to follow the track in preference to the "conformity line," I have more than justified this by building a truck which is admitted to have certain merits, for which I invite criticism, but that criticism must be founded on fact; and at the risk of being considered egotistical, I must in future refuse to discuss the running qualities of any railway or tramway vehicle in terms other than those based on the "conformity line."

J. Sutherland Warner.

London, S.W., *October* 12*th*, 1907.

Electrical Contracting.

With reference to your leading article on "Electrical Contractor or Ironmonger," in the current number, I read the same with a great deal of pleasure, as it entirely corroborated the few remarks that I made in your contemporary last week. There are, however, one or two points to which I wish to call your attention, namely, my Association do not attempt, nor do they wish to prevent any reputable firm whether ironmonger or furniture-dealer, taking on electric contracting work, assuming that they have the necessary qualifications. Our chief wish is, as you say, to do away with the cheap and nasty work, and the cut-throat competition of the mushroom contractor, who is here to-day and gone to-morrow.

Again, I notice that you say my Association is opposing the rules of the Home Office, which have for their object the enforcement of a certain minimum standard of workmanship. I beg to state that we are not opposing on these lines at all. Our opposition, as opposition, is only to ask the Home Office to incorporate in their rules the existing rules and regulations, to which we now have to work, and which are to a large extent more or less in opposition to each other.

As you are well aware, we have to conform with the Board of Trade Regulations, the regulations of the Institution of Electrical Engineers, the varied regulations of the different borough engineers, the rules of the different supply companies, and last, but not least, those of the fire insurance companies.

The new rules of the Home Office as submitted to us in some points emphasise, and in other points minimise, the rules in the above list, and our opposition was entered into so as to enable the Home Office to draw up some series of rules that could be officially enforced, and that would in themselves combine and bring into harmony the whole of the existing rules and regulations.

Leonard G. Tate,

Hon. Sec., The Electrical Contractors' Association, Incorporated.

London, E.C., *October* 14*th*, 1907.

Rail Corrugations.

Rail corrugations have again been the subject of a paper, and the discussion showed that many engineers attribute the trouble to the rolling mills, and that grinding methods are commonly employed to temporarily get over the trouble.

The writer would be interested to know whether any engineer has marked the position of, say, the crest of the wave along a length of rail before thoroughly grinding out the corrugations; if so, and the corrugations have again appeared, what position the new wave has taken up in comparison with the old one.

C. G. M. N.

Lancaster-Heysham Electric Railway.—The overhead equipment of this electrical section of the Midland Railway is expected to be ready early next year. Some of the trains, consisting of a 300-H.P. motor, coach and two trailers, are practically complete.

POWER OFFICIALS AND THE NEW REGULATIONS.

We are informed that a meeting of representatives of the electric power companies and of a number of municipal authorities in the West Riding of Yorkshire was held at Leeds on Friday, October 4th, to consider the Draft Regulations for the Use of Electricity in Premises under the Factory and Workshop Act, 1901, issued by the Home Office. The meeting was called at the instance of the Society of Power Company Officials, the following being present:—W. A. Chamen, South Wales Electric Power Distribution Co.; S. E. Fedden, Sheffield Corporation; A. B. Mountain, Huddersfield Corporation; H. A. Neville, Wakefield Corporation; J. J. H. Stansfield, the Yorkshire Electric Power Co.; D. A. Starr, the Clyde Valley Electrical Power Co.; C. D. Taite, the Lancashire Electric Power Co.; T. W. Watson, the Newcastle-on-Tyne Electric Power Supply Co.; W. B. Woodhouse, of the Yorkshire Electric Power Co., who is the honorary secretary of the society.

[Our readers will remember that the Regulations were printed in the Electrical Review for August 30th, 1907, p. 329.]

The following Resolution was passed unanimously: "That, in the opinion of the meeting, (*a*) some regulations affecting the use of electrical energy in factories and workshops are necessary, but that any regulations issued by the Home Office should be on the lines of the existing Board of Trade Regulations, and that both sets of Regulations should not apply to the same premises.

"(*b*) If there should be a difference of opinion with the local inspector on the administration of the Regulations, there should be a right of appeal.

"(*c*) A reasonable time should be allowed before any regulations that may be made be enforced, so as to allow for existing work and work in progress to be brought within the requirements."

The Regulations were then gone through *seriatim*, and it was decided to make the following suggestions:—

Reg. 1.—Add "so far as is reasonable and practicable" after the word "danger." This addition is suggested in a number of cases, as it was felt that, if the Regulation was drastically enforced, it would, in many cases, be impossible to continue the use of electricity in factories at all.

Reg. 2.—Delete this Regulation, as part of it is already covered by Regulation No. 1, and part is impracticable. This Regulation would, having in view the definition of "cable," prevent bare overhead wires for crane work, bare bus-bars, &c. See also Regulation 10, where a bare conductor is anticipated.

Reg. 3.—Add after "isolating link" "so far as is reasonable and practicable."

Reg. 4.—Add "except where such are used as isolating switches only and not to break circuit under load."

Reg. 5.—Add "This Regulation shall not apply to fuses the property of and under the control of an authorised undertaker."

Reg. 6.—Not objected to.

Reg. 7.—Delete "circuit" and add "installation or main circuit." The definition of circuit makes the Regulation as drawn quite impracticable.

Reg. 8.—Delete from "and every" to "so protected."

Reg. 9.—Not objected to.

Reg. 10.—Add "except in the cases of overhead lines or bus-bars."

Reg. 11.—Not objected to.

Reg. 12.—Delete "electrical motor" to "horse-power," and insert "installation" in the second paragraph. Delete the third paragraph. At present it would not be practicable to carry out paragraph 2 of this Regulation as the cost of a small motor with this protective device would be prohibitive. Paragraph 3 would, in some cases, necessitate a motor switch in more than one room, and would be impracticable.

Reg. 13.—Delete the second paragraph. This is an unnecessary and unusual precaution, and would not in practice be an additional protection.

Reg. 14 to 16.—Not objected to.

Reg. 17.—Strike out from "for low pressure" to end. Substitute "reasonable" for "ample." Strike out second paragraph. To carry this out would mean in some cases a very great expense. It also does not seem that arbitrary dimensions are necessary or politic as passages of less width may be perfectly safe, and conversely of greater width may be dangerous. It appears to be a case in which each case should be treated on its merits.

Reg. 18.—(*a*) Add "so far as is reasonable and practicable"; (*b*) strike out as being unnecessary; (*d*) add after "may" "so far as is reasonable and practicable."

Reg. 19.—Add "so far as is reasonable and practicable."

Reg. 20.—Not objected to.

Reg. 21.—Add after "such metal shall," "so far as is reasonable and practicable."

Reg. 22 to 24.—Not objected to.

Reg. 25.—Add after "free," "so far as is reasonable and practicable."

Reg. 26.—Not objected to.

Reg. 27.—Add after "and," "so far as is reasonable and practicable."

Reg. 28.—Delete this Regulation, and insert the Board of Trade Regulation No. A6 of 1905.

Reg. 29.—Not objected to.

Reg. 30.—Delete from "used" to "electrical energy." It is not required that instructions as to the treatment of persons suffering from "gassing" in the case of suction gas plants should be affixed, and the Regulation is making an invidious distinction between premises in which electricity is used and other motive powers, and is calculated to greatly restrict the development of electricity.

Reg. 31.—Insert "unauthorised" "before persons." This Regulation would prevent the switching off of a transformer by means of an insulated rod from the outside of a sub-station, or portion of a room used as a sub-station, and so be rather a cause of, than prevention of, danger.

Reg. 32 and 33.—Not objected to.

It was decided that separate representations should be made to the Home Office, and an official representation will also be made by the Society of Power Company Officials.

PROCEEDINGS OF INSTITUTIONS.

The Possibilities of Electrical Development.

By R. Borlase Matthews, Wh.Ex., A.M.I.C.E., A.M.I.E.E.

(*Abstract of paper read before the* Birmingham and District Electric Club, *October 10th*, 1907.)

That a central station which has been in operation for a considerable time ought to be in a better position than a more recently established one is a fact that most people will accept; the people of to-day need educating as regards the uses of electricity. Because the older station has had time, in which it has gradually and slowly carried out this education of the people, it is therefore in a better position than the new one.

Now time is but the sequence of ideas, and the public in any district would take two years instead of ten in learning to appreciate electricity, provided that the sequence of essential ideas about electricity were accelerated five times.

The accumulated experience of many people in the applications of electricity must be gathered together and the essence presented to prospective customers in such a way that, busy though they may be, they may rapidly be brought to the point at which they can intelligently consider whether or not electricity would meet their needs better than anything else, and appreciate that nowadays electricity is a luxurious necessity rather than necessarily a luxury—and a convenience that no one who can afford the ordinary comforts of civilisation need fear to add to his home.

It is hardly necessary to point out the great advantage that commercial development of electricity will be, both to those who are connected directly with the electrical industry and to the world at large; and if it is possible by the systematic presentation of such facts as are stated above, to bring about this desirable condition of affairs in two years instead of ten, it is surely of vital importance to exert every effort in the required direction.

The channels through whom these facts are to be conveyed to the general public are the central station managers and the manufacturers of electrical apparatus. But few of the former seem to be as fully alive to their opportunities in this line as they might be, while the latter are doing very little compared with the possibilities which lie before them. Yet it is obvious that while the central stations are the first to benefit by any increase in the use of electricity, the manufacturers will also in a short time feel the benefit thereof, and that therefore the interests of both classes are intimately bound up in a campaign of this nature.

As regards the central stations, nearly one-half of the population of the country is already to be found within their area of supply, and this area must logically increase as time goes on, since in accordance with the laws of economics the private plants that are brought within the area of supply must gradually give place to the central stations, which latter in addition to the low generation costs, have the advantage of good diversity and load factors. Now the central station is in its very nature monopolistic, and subject therefore to no competition for a like service. In consequence, laying aside any other adverse conditions, it lacks the keen and constant commercial stimulus which is such an aid to progress. It likewise lacks, by reason of its isolation, both the ready opportunity for, and also a very great incentive toward, that aggressive co-operation with manufacturers, contractors, and other central stations which would be beneficial to all parties concerned. For central stations not competing against one another are therefore in a position in which extensive co-operation could be the means of bringing about results not only far beyond any success of the past, but also surpassing even their most sanguine expectations.

The manufacturers of electrical apparatus, too, need to be more thoroughly awakened to the advantages that will accrue to them from a more extensive use of electricity. They are now occupying themselves chiefly in urging upon their customers the merits of that particular apparatus which they manufacture. If, in addition to this, they could be induced to put before the public the general advantages of electricity for those main purposes for which their apparatus is manufactured as an auxiliary, then the more general use of electricity would create a greater demand for what they wish to sell, and their business would be more pro perous than was previously the case.

In this matter of electrical development all connected in any way with the electrical industry must co-operate if the maximum of result is to be obtained by the minimum of effort.

Representatives of these different interests having met together, a definite scheme or plan of campaign must be prepared in order that every inch of ground may be covered, and that without overlapping. The advantages of new business resulting from such a

campaign will, of course, benefit all concerned. At the same time an artificial condition of affairs is not brought into play, since the existing competitive trade relations, so essential to true progress, are not in any way removed; for of the orders that the new business has rendered available, the proportion that will be obtained by each manufacturer will depend entirely upon his individual activity. Competition will certainly be lessened to a degree owing to the greater demand, and at times even, an embarrassment of unfilled orders will occur, but that will not be to the disadvantage of any manufacturer. Further, it is quite reasonable to anticipate that the evolution and growth of the campaign will tend to general improvement and harmony in trade relations, which means again, within certain limits, increased selling and distributing efficiency.

These various sections of the electrical industry co-operating together in a combined educational movement along the lines that have been suggested, may, for the purpose of reference in this paper, be designated the "Electrical Association."

The scope of such an electrical association is a very wide one; in its initial stages it will have to progress comparatively slowly, so that those most interested in it may be satisfied as to the results it is bringing about; and as confidence is established it will be able to branch out and produce exceedingly satisfactory returns. In an educational or advertising campaign it is not easy to adduce direct evidence of results obtained. However, experience has shown that contemporaneously with the adoption of a good system receipts do advance remarkably, and that also any reduction of expenditure in this direction brings about a corresponding decrease in the income.

The first step of the Electrical Association should be to impress upon the manufacturers and dealers in supplies the previously mentioned underlying idea of the whole scheme, namely, that which benefits electricity as a whole is bound in the end to benefit also the individual branches of the industry. Therefore all must work together for the common good. This preliminary movement is by no means so easily accomplished as might be supposed, on account of the long-standing and deep-rooted ideas about the necessity of constant rivalry in trade, and also on account of the prevalent distrust and suspicion with which manufacturers have been accustomed to regard each other. For this reason, the assistance is required of the professional institutions and trade associations.

When once the manufacturers and dealers in supplies have realised the necessity of a co-operative educational campaign, they must approach the central station managers in order to bring them first to an appreciation of the possibilities of the development of the supply of electricity, and secondly, to bring them to a clear understanding of the necessity for concerted action with all connected with the electrical industry in any way.

The electrical wiring contractors and dealers also need to have the subject of the extension of the business brought before them in a similar way, the matter, of course, being dealt with from their standpoint. This line of work is of fundamental importance to all electrical interests, as a building correctly wired is an almost certain user of electric service. On the other hand, thousands of possible customers are lost on account of properties not having been wired in the past.

When the plans of the Association for the development of the central station field are well under way, further plans must be considered for the organisation of a general publicity scheme on a much more indirect, yet exceedingly valuable basis, namely, through the Press.

Now, there can be no question that electricity is one of the most interesting subjects in the world. It is only necessary to describe some novel application, and it immediately becomes news. As such, if properly handled, a great deal of space in the newspapers throughout the country could be employed to further the objects of the Association. These notes, in addition to telling of the novelties of the day, should also give information as to novel uses of old objects, showing in a practical way, though not too pointedly, how any reader could make use of the same things himself. This is publicity of a most valuable kind. The local central station could follow it up directly. If conducted properly the results obtained should be extremely satisfactory to newspaper proprietors and readers alike, as well as to those who are engaged in an industry which represents the latest practical benefits of science and progress.

This proposal for the formation of an Electrical Association is, admittedly, an attempt in a very small degree to get away from the competitive extension of a market, and to reap the advantages which must accrue when commercial effort is directed and massed, without competitive opposition from within, toward popularising the service and extending the business.

The sales expenses of electrical manufacturers are keenly competitive. For every increase in selling expense or increased gain in business, on the part of one manufacturer, a corresponding effort is necessitated on the part of others, analogous to the maintenance of the navies and standing armies of the nations.

This necessary competitive strain is very largely for business which is either already existing or else resulting from the normal growth in business generally; whereas, the object of the Association would be to open up a market beyond this, a market snatched from the future, that cannot be developed now, except by co-operative means.

However, the idea on which the Association is based will not come into conflict with the present system, for it strikes a higher plane, leaving existing conditions as they were.

The ground upon which is based the contention that co-operation is both fair and feasible for all the manufacturing interests, is the almost absolute dependence of one interest upon the others, and the dependence of all connected with the electrical industry upon the public with its tremendous purchasing power. The popularising of electric service to this final market is certainly a common object, on the basis of which co-operation is correctly founded.

Such a scheme as has been outlined, if fully developed, will mean the expenditure of a considerable amount of money, and the question arises as to how the funds are to be raised and how proportioned out among the contributors.

Since an increase of sales resulting from a combined electrical development campaign does not depend in any way directly on the capital investment of the individual manufacturer or central station, but rather on the individual activity of each, the contribution must logically be based as a percentage upon the sales.

The municipalities and the lighting companies should also be called upon to contribute to the Association, since they are going to derive benefit from its operations. From the point of view of the interests of all connected with the electrical industry in any way, many of the municipalities will have to be stirred up to get business in somewhat the same energetic way that West Ham and one or two other municipalities are doing to-day. It will be no use to put forward objections to the effect that the Local Government Board or other authorities stand in the way, for if the Association were formed, one of its early duties would be so to arrange matters as to facilitate any legitimate expenditures necessary for the proper development of municipal undertakings.

Before turning from the question of expenditures, it must be pointed out that the Electrical Association should be formed on such lines that it does not make profit or declare a dividend. Neither should it engage directly in the business of selling electric current or manufacturing or selling electrical machinery, apparatus or supplies of any kind, since it should be a co-operative body existing for the mutual benefit of its members. If it were in any way a profit-earning concern it would not inspire confidence, and so would defeat its own ends.

More especially during the past year central station engineers in this country have begun to realise that it is as necessary to adopt modern commercial methods for selling electricity as it is to sell any other commodity. In addition to this, the fact is beginning to be appreciated that although electricity is in open competition with other less advantageous means of providing the lighting, heating and power required by the public, yet the amount sold is not anything like proportionate.

It is unfortunate that in the early stages of the application of new methods to the commercial development of electrical undertakings, the work is often carried out in a half-hearted way, for the results, as compared with the expenditure, are then far from satisfactory. However, even a half-hearted attempt is better than no movement at all, as it gives the far-sighted manager an opportunity of testing the new methods, and thereby realising something about the possibilities of which they are capable if carried out on a larger and more systematic scale.

The commercial sales department of a central station, if aggressively conducted, will accomplish results in a year or two that otherwise would not be obtained for many years under the more ordinary methods. Therefore it behoves the supply authorities to investigate these methods, and to make it their business to increase business—to increase their load factors by every honest logical means, taking advantage of every modern commercial method that will serve their purpose.

It would be wise to commence the keeping of records of the operation of the commercial sales side of the business, so that questions regarding important commercial problems could be asked and answered readily and with certainty. These records should be kept in such a way that the results obtained in one town may be compared with those obtained in another town. The most satisfactory general basis of comparison seems to be the income per cap. per annum. This method, while not a strictly accurate one, gives an excellent idea of the commercial activity of each town. Where the prices per unit are low, the income per cap. per annum is usually greater than where they are high, indicating that low prices induce more people to become consumers. Taking the average of English towns having populations varying from 70,000 to 175,000 it will be found that the average total income per cap. is 4s. 10½d. This amount, representing the income per cap. of central stations in this country, varies from 2s. 3d. to 14s. 10d. There are 47 undertakings only which have an income per cap. of 7s. 6d. or over. With a properly conducted campaign there is no reason why the total income should not reach 15s. per cap. per annum. In those American cities where an active campaign has been carried into effect the income per cap. per annum ranges from 20s. to 24s. In other American cities which have not adopted an aggressive movement for new business the income per cap. is about 5s.

In the United States of America an association was initiated two years ago under the title of the Co-operative Electrical Development Association, which has done excellent work in advancing the electrical industry. The bases of its operations are very much the same as those laid down in this paper, but adapted to American conditions. The expenditure in the promotion of the objects of the association was £11,000, and liabilities to the extent of £2,000 incurred for work in progress; by the aid of this money, central stations have been induced to spend £110,000 in advertising and canvassing, with a result that the equivalent 8 C.P. lamp connections added were about 5,500,000, or, in other words, apparatus having a total demand of 140,000 KW. This necessitated a capital expenditure of approximately £2,700,000 for the necessary generating and distributing plant required to supply these additional connections, and an income to the central stations for current sold of £1,400,000—an expenditure which would fully justify the disbursement of a much

larger sum than £11,000. So great has this success been that the campaign for 1907 is to involve a total expenditure of £32,000. As a result of the work of the association, 163 American central stations have inaugurated showrooms, 193 have commenced the systematic distribution of magazines and advertising matter, 223 have started newspaper advertising, 181 began the operation of their own electric sign, 165 have added 331 canvassers. The increase in the lamp business was 25 per cent. over that of 1905, as contrasted with an increase of 8 per cent. in 1905 over 1904 and 5 per cent. in 1904 over 1903.

This story of success is one that should set British electrical manufacturers and central station managers seriously thinking as to whether it would not be of great advantage to form a somewhat similar association in this country, not necessarily along the same lines as the American association, but modified to suit the needs and customs of an older civilisation. The electrical industry cannot even, in these days of general prosperity, be said to be, as a whole, in a very satisfactory financial position as far as profits on capital invested are concerned. The undeveloped field for the use of electrical apparatus is great, so surely any successful means of development must place all concerned with the electrical industry in a much better position.

Undoubtedly the difficulties will be greater here, but the potentialities of the general idea of popularising the use of electricity for light, heat and power, is so great that it is well worth while overcoming them.

The Training of Engineers.

At a meeting of the Post Office Institution of Electrical Engineers held at St. Bride's Institute on Monday evening, October 14th, Major O'Meara, C.M.G., the President, delivered the inaugural address.

After referring to the retirement of Sir John Gavey, C.B., from the position of engineer-in-chief to the Post Office, and the honour of knighthood which had been conferred on him by the Sovereign, Major O'Meara said :—

No subject, probably, has been more discussed in engineering circles within recent times than that relating to the technical education of engineers and artisans. Many eminent men connected with the engineering profession have dealt with this question in their addresses, and have given expression to views which are well worthy our serious consideration. The subject is one of immense importance to us, affecting as it does the success of all our operations. Money can purchase the best of material, but to employ it to the greatest advantage requires that we shall have at our command well-educated officers to direct highly trained workmen. To deal with the subject fully would necessitate many evenings being devoted to it. But many other important questions demand our attention, and I fully realise that we have not the time at our disposal to do more than just touch on the fringe of the subject to-night. I think we are all ready to admit that in our profession technical education cannot consist in learning by rote something in the nature of a series of prescriptions, one or other of which will later prove to be the solution of each of the various schemes which may be handed over to us to work out in the course of our careers. What is it then that the professional education of our engineers should aim at? To quote Pope :—

> "'Tis education forms the common mind,
> Just as the twig is bent, the tree's inclined."

These lines apply as truly to professional as to general education.

We are associated with a branch of engineering in which advances have been, in the past, rapid and continuous, and so far as I can see, the time to call a halt in connection with the march of progress and improvements has not come yet. Engineering already covers a very wide field, and every day the portion of it which the telegraph engineer has to deal with in his work daily, is becoming greater in extent. It is not to be expected that individual officers can possess expert knowledge of all branches of engineering affecting their work, but it is essential that one and all shall possess a thorough knowledge of the fundamental principles and laws on which engineering science is based. And the minds of our engineers should be so formed by their professional education and training that, in later years, no matter what the nature of the task presented to them for execution in the ordinary course of their duties, still they should be able to pick out intuitively the principal features of the problem before them, and if any of these are new to them, they should be in a position to obtain, by a process of accurate reasoning, a solution of these novel aspects.

If courses of instruction are properly designed to develop the student's mental equipment on the lines indicated, then such as have been attentive and industrious in connection with their theoretical studies, and, in addition, have been observant when engaged on practical work, cannot fail to rise to the occasion when the demand is made on them.

Success does not depend entirely on book learning, important though this is: other qualifications are also necessary in our service as in all other callings. If I were asked what is required for success, I would unhesitatingly reply that according to my own experience, the following is the order of importance of the qualifications which make for success:—

(*a*) Personal equation.

(*b*) Commercial aptitude, or its equivalent, administrative ability.

(*c*) Quality and extent of professional knowledge.

Some of you are no doubt surprised at the order in which I have enumerated the above qualifications. To these I would suggest that it would be well for them to examine the qualifications of acquaintances who have been successful in life and whose characteristics they know sufficiently well. I shall indeed be surprised if my own experience is not fully confirmed by those who carry out the investigation suggested.

Let us consider the above qualifications a little more in detail. Many elements go to make up the personal equation of an individual. To enumerate but a few of the important ones, I would mention initiative, mental capacity, industry, trustworthiness, resourcefulness, tact, judgment, perseverance, loyalty and good address. Some of these qualities are no doubt a gift of nature, but, believe me, when they are not so provided they can be often acquired, to some extent, by cultivation. They are by no means all of equal importance, nor are they always of the same relative importance and value in every case. Rather does the rank and position of an officer determine the relative value of each of these qualities in any particular case. There is one element in the personal equation which I have not mentioned so far, but a reference to which I ought not to omit. I have in mind the power of an individual to solve the personal equations of his subordinates. This instinct is certainly required, in some degree, by all officers in responsible positions, and in the higher ranks the possession of it is absolutely indispensable. I would commend to your notice an address given by Mr. J. Hayford, in America, entitled, "Why not Teach about Men, the most Important and Difficult Tool an Engineer Uses?" You will find there much of interest to you. He most truly remarks, "A correct judgment of men is more difficult to attain, but is also more important than a correct judgment of materials."

The second of the main considerations required for success mentioned by me was commercial aptitude. This qualification requires in its possessor the power to control the organisation under him in a manner to ensure that all the resources of men and material at his command are employed in turning out work of high efficiency at the most reasonable cost. To achieve this end, waste in all its forms must be checked, and running costs must be strictly controlled. It is alone by attention to these matters that some return on the capital expended can be looked for, and an undertaking made a commercial success. In former times, when our duties were connected chiefly with the maintenance of the public telegraphs, and our officers were not brought into such contact with individual members of the public, as is the case to-day, economy had certainly to be studied. In those days our organisation was not large, and therefore the control and check of expenditure could be very minutely exercised from headquarters. Economy claims our attention no less to-day than in former times, but our organisation has now become vast, and we are further charged with the duty of providing particular services to meet the requirements of individuals, some of whom naturally have fancies of their own. These factors cannot fail to render a very close check on expenditure increasingly difficult, and it has therefore become infinitely more important that officers of even very junior rank should pay a closer attention to those matters which are so intimately associated with the administrative side of our work, and thus add to the efficiency of the control and check on our expenditure. That is to say, we must look for the development of commercial ability at an earlier period in the careers of our officers now than was formerly the case.

The position in which I have placed the third of the main considerations affecting success must not be taken to imply that I depreciate the value of knowledge. This is by no means the case; on the contrary, I thoroughly endorse the advice contained in the following lines :—

> "Seek knowledge, as if though wert here forever;
> Virtue, as if death held thee by the bristling hair."

It is pretty clear that one can never afford to cease one's studies. Experience has taught me that there is no short cut to knowledge: many long years ago, I fear, I cherished the delusion that such a short cut existed, and I consulted a brother officer in the hope that he would furnish me with a few useful tips which would have enabled me readily to successfully compete at a certain examination. His reply sorely disappointed me, for he informed me that it would be necessary for me to read widely, and read hard, if I ever hoped to accomplish my purpose. He increased my disappointment by forwarding me a large parcel containing publications and books full of notes made by himself. To-day I am ready to freely acknowledge that no advice which I have received in my life has been so profitable to me as that to which I have referred.

The advance in engineering knowledge continues steadily and rapidly, and the real difficulty which exists is that connected with the apportionment of a student's time, so that it shall be devoted in a satisfactory proportion to each of the various subjects affecting his profession, in accordance with their relative value in his work. New matters are continually forcing their attention on ourselves, as well as on all others who are engaged in some branch or other of engineering, and it is, I must confess, somewhat difficult to decide on the subjects which should be included in the professional education of our officers. Hitherto the engineering schools of this country have not provided a complete course of instruction for students desiring to adopt the career of a telegraph and telephone engineer. It is true that in many schools instruction is given in each of the individual subjects which are essential to a student wishing to follow our calling; still, I can quite imagine that the young aspirant to a telegraph engineer's career must find it somewhat puzzling to select exactly those subjects on which he can most usefully concentrate his attention. His difficulty, it is true, arises wholly from inexperience, for there is material to guide him in his choice of subjects, but naturally he can hardly be expected to look in the proper quarter for the inspiration he requires. The Indian Government for many years has provided a special course of instruction at the Royal Indian Engineering College, Cooper's

Hill,* for the engineers required in the Indian Telegraph Service, and the French and German Governments have met their own requirements by providing special courses of instruction for those officers already in their services, who are intended to fill the superior engineering appointments in the Telegraph Departments of these countries.

Lastly, many of the engineering schools in America have also, in recent years, provided instruction of a specialised character for those of their students who wish to follow the career of a telephone engineer.

There are many in the audience before me who, I feel sure, wish to become engineers in our own telegraph service, and I can give no better advice to them than that they should examine the courses of instruction planned by the Indian, the French, and the German Governments and those of the American Engineering Colleges referred to. They will be wise, then, to arrange their own studies so as to include the subjects of the curricula mentioned. It will be found that in addition to such subjects as telegraphy, telephony, construction of aerial and underground networks, building construction, and steam engines, the subjects of administration, finance, political and social economy also form part of practically all the courses referred to by me. The importance of including subjects of a commercial as apart from a purely engineering character in the education of an engineer is, I am glad to find, now becoming very generally recognised. And I would call your attention to the following reference to this matter in an address given in America by President Humphreys, of the Stevens Institute, whose words were :—

"I contend that every engineer student should have some instruction in the principles of accounting, in depreciation, business law, patent law, banking, specification, and even sociology. And in connection with the business side of their training, they should be made to see the importance of the correct use of language."

I feel that it is quite possible that there may be a few among the younger members of the Institution present here to-night who will be wondering what value some of these subjects may have for them. For instance, as regards the principles of accounting, the argument may be advanced that we are employed in a Government department, that Parliament votes supplies which we have to spend on works decided upon by the Postmaster-General. Further, that our accounts have to be prepared in a particular way, so as to meet the Regulations framed by the Lords of the Treasury, and, therefore, a knowledge of commercial accounting is likely to be of very little use, if at all, to our own engineering officers. Now, I feel that it is for the very reason that our accounts are prepared in a special way that a knowledge of the principles of commercial accounting, is particularly valuable to our officers. Let me explain why. In connection with our telephone system, we provide individual services, and naturally those availing themselves of such services are called upon to pay the full cost of the same to the department. The method in which our expenditure has to be recorded, does not enable us to pick out, at once, from our ledgers, the exact annual value of each service which the department provides, but a knowledge of commercial accounting, and of the basis on which the charges to the public should be framed, however, readily enables us to translate the various items recorded in our ledgers into the appropriate elements which represent the annual cost of each service from a commercial point of view. But there is much more than methods of book-keeping to be learnt from a study of commercial accounting; to take but a few matters, I would mention methods of preventing fraud; systems of paying wages, both from the accounting and administrative standpoint; the organisation of accounts in relation to administration. Then again, the value to our officers of some knowledge of business law and banking may not be quite clear. But I would remind you that nowadays we have to deal largely with contractors and others; and in the future we shall have to do so more and more. Our relations in these cases must be governed by the same general principles as those which rule in ordinary commercial life. There are many pitfalls for the inexperienced man engaged in business, and it is necessary for every man to have some knowledge of the various ordinary legal points met with in business, in order that illegal acts may not be committed inadvertently. And, further, when difficult questions arise, such knowledge will often indicate whether it is worth while to seek legal assistance in dealing with the matters involved. Again, at times, financial crises and questions bearing on the Money Market are likely to indirectly affect our interests, and as problems connected with such matters are studied in connection with banking, a knowledge of this subject will not come amiss. Further, officers who rise to high positions are often called upon to frame regulations for the administration of the branch under their control. It is perhaps on such occasions that the fullest advantage is derived from the knowledge of commercial law and many other business subjects. We can rarely go wrong if we imitate sound commercial methods in our own administrative decrees. The value, to an engineer, of a knowledge of depreciation, patent law and specification is so self-evident as to call for no remarks from me. The subject of sociology, on the other hand, I feel that I cannot dismiss quite in the same way. Apart from its bearing upon our relations with those with whom we have to work, the subject is really one of the greatest interest to all thoughtful men. The theory of society is continually undergoing changes, and it certainly seems to me that officers who wish their administrative efforts to be successful, will find it profitable to keep in touch with the aspirations of the various classes of workers in this country and also abroad, and further, to devote a little time to the study of the problems connected with the science of human society. I do not, for one moment, wish to suggest that you should seek inspiration from Plato and Aristotle, the fathers of the science of society, nor from the writings of Bentham and Mill. But I do feel that we can all, with real advantage to ourselves, devote some attention to the articles relating to sociology which so constantly appear in the columns of the current issues of our leading magazines and newspapers.

The foregoing considerations leave little doubt that the knowledge required by our engineers should cover a wide range of subjects, and it goes without saying that whatever there is of it, should be built up on an absolutely sound foundation.

In conclusion, I wish most strongly to impress on the younger members of this Institution that although an engineer's work must be based on theory, yet practical experience alone can make an individual an engineer in anything more than title, and he can no more disregard the commercial aspect of his work than can the manufacturer, and consequently his education must be directed to this end. I hope that I may have succeeded in showing how important it is for each of us to study our own characteristics, as well as those of our subordinates. How this is to be done is a question which I fear must be left to each individual to solve for himself: those who best succeed in doing this will reap the richest reward. And I have also endeavoured to give some indication of the direction in which this Institution can help us all. I have mentioned certain subjects which are of immense importance to us, but which in the past have not been as generally recognised to form part of an engineer's education as should have been the case. It would be of very valuable assistance to us, I think, if our Council were to induce some who are masters of these subjects to give us the advantage of their knowledge and experience by reading papers on their own special subject during the ensuing Session. This Institution is still very young, but it cannot fail to grow in usefulness, and I have visions of the many benefits which it will be able to confer upon us all. I can only trust that the ensuing Session will be as great a success as was the past one.

* The Indian Government decided to close this College, but the curriculum of the course may be found in the *Calendar* of the Royal Indian Engineering College, Cooper's Hill, published by Messrs. Harrison & Sons, 59, Pall Mall.

LEGAL.

Mayor and Corporation of Bournemouth *v.* The Poole and District Electric Traction Co., Ltd.

This case was mentioned to Mr. Justice Joyce in the Chancery Division on Tuesday.

Mr. Tomlin, for the Poole company, said his clients owned a tramway undertaking, and on March 11th, 1903, entered into an agreement to sell the undertaking to the Bournemouth Corporation. That agreement was afterwards confirmed by statute. The consideration for the sale and purchase was the payment to the company of £5,500, and a further sum, to be ascertained in case of difference by arbitration, equal to the fair market value of the undertaking. For that purpose the balance-sheet of the company made up to October 31st, 1901, was to be taken. The matter went to arbitration before Mr. Justice Lawrence, who found a sum. Eventually the purchase was completed subject to certain outstanding questions, which were the subject of the action. All these questions had been disposed of except two, which arose on the 4th clause of the agreement. The sale was made subject to all liabilities and engagements of the company incurred or entered into in the ordinary course of business in connection with the Poole undertaking outstanding or undischarged on the appointed day, which was December 31st, 1903, being indemnified by the Corporation. The two items were £7,000 in respect of a loan from the London and South-Western Bank, utilised for discharging liabilities to creditors in the ordinary course of business, and £4,558 3s. 8d. in respect of liabilities to sundry other creditors. When the matter came before the present Court, his Lordship referred it to Mr. Sneath, an accountant, to report whether all or any part of the two sums were liabilities or engagements of the company incurred or entered into in the ordinary course of business. That report came before the Court on the further consideration of the case in April last, and his Lordship was not satisfied with the meaning of the report. Mr. Sneath had now answered certain questions put to him in favour of the company, viz., to the effect that a large part of the two items was a liability incurred in the ordinary course of business.

Mr. Hughes, K.C., for the Corporation, submitted that Mr. Sneath's report was not binding on the Court. With respect to the item of £4,558 which the report had reduced to £2,330, he urged that the Corporation could not be asked to pay the company anything in respect of capital outlay, as they had already received it in the award. With regard to the item of £7,000, which had been reduced to £6,476, it was impossible for the company to show that it was borrowed in respect of the undertaking at all. In point of fact, £3,000 of it was applied to the payment of a dividend.

In the result, his Lordship held that the company was entitled to £6,476 odd out of the £7,000 bank loan, and £2,570 part of the £4,558, on the ground that they were liabilities and engagements of the company incurred in the ordinary course of business in connection with the Poole undertaking outstanding or undischarged on the appointed day as defined in the agreement of purchase. He directed each party to pay its own costs.

NORTH METROPOLITAN TRAMWAYS CO. *v.* LEYTON URBAN DISTRICT COUNCIL.

In the King's Bench Division of the High Courts of Justice, on Monday, October 14th, Mr. Justice Phillimore and Mr. Justice Walton, sitting as a Divisional Court, had this case before them. It was one in which the tramway company appealed against the decision of Mr. Graham Harris, who, as arbitrator, fixed the amount of compensation payable by the District Council to the company upon the acquisition by that authority, of so much of the company's undertaking, described as Tramway No. 13, as was within its area. Mr. Graham Harris assessed the amount of compensation payable on the basis that the Council were compelled to take the whole of the undertaking in the Leyton Urban District in the public streets, and a spur line leading from the main line to the gates of the works or factory of the company situated at Leyton, but he held that the factory itself and other land, comprising a total area of 77,000 sq. ft., were not suitable or used for the purposes of tramway No. 13, being a factory where the company repaired and constructed cars for the whole of their system, including those portions acquired by the London County Council and the East and West Ham Borough Councils, and he accordingly declined to make any allowance in his award for the works and land in question. The company appealed against this decision and sought to have the award set aside.

Mr. Danckwerts, K.C., Mr. Hutchinson, Mr. Frank Richardson and Mr. Devonshire appeared in support of the appeal; and Mr. Balfour Browne, K.C., Mr. C. A. Russell, K.C., and Mr. Courthope Munroe were for the respondent Council.

The appellants urged that, inasmuch as the arbitrator had awarded a part, the Council, by their agreement, must take the whole, and that Mr. Graham Harris had no right in law to create such a severance as he had done.

MR. BALFOUR-BROWNE maintained that the arbitrator's award was good as one deciding a question of fact and should stand. He complained that the company, when the matter was before Mr. Justice Bigham, elected to treat it as a question of fact, and that the matter was sent back to Mr. Graham Harris to be so decided, now he had decided that the factory was not suitable or used for the purposes of the undertaking, the company appealed and raised points of law.

Their LORDSHIPS gave judgment on Tuesday. They dismissed the appeal, holding that the local authority were not compelled to take the car factory. The company, however, were entitled to be compensated for the easement of the land inside the gates of the factory on which the tramlines had been laid, and no doubt the arbitrator in making his award had taken that into account.

Leave to appeal was granted.

EARTHING THE NEUTRAL POINT.

BY E. V. SHAW.

THE earthing of the neutral point on a three-phase system is a subject that appears to have been approached from diametrically opposite points of view by different engineers.

Some adopted the plan of earthing the neutral in as many places and as solidly as possible, while others did not earth it at all.

As one would expect, however, time and experience have brought these two extremes to one point of common practice, which is, that the neutral of a three-phase system should be earthed at one point only, and that through a suitable resistance.

It may be of interest to trace the steps which have led to this from such different ideas. By the plan of earthing the neutral, the possible potential between the conductors and earth was practically halved (to be exact, it was divided by $\sqrt{3}$), and to make this doubly sure, the star of every star-wound generator and motor was connected direct to earth.

Theoretically, this is excellent, but in practice the drawbacks are (*a*) that it is only necessary for one phase to break down for there to be a short circuit which will cause a heavy rush of current which, if only on a motor circuit, will probably be sufficient to upset the whole system; (*b*) that considerable earth currents are likely to circulate between the generators and motors, and even between the generators themselves.

Now, where the neutral is not earthed, the breakdown of the insulation of one phase does not at once cause sufficient current to flow to trip out the automatic switches through which the faulty conductor is fed, but a discharge takes place at the fault which very speedily destroys the insulation of the other conductors in immediate proximity, and a very violent short-circuit occurs. It has been found that these shorts were so heavy that the automatic switches through which the faulty conductor was fed opened with a loud report, usually spilling most of the oil in the switch tanks, and sometimes breaking the wooden rods on which the cross-arms joining the fixed contacts were carried, and the arc set up, acting as a vibrator, often caused the breakdown of the insulation in other parts of the system.

Those who favoured the insulated neutral argued that with it earthed there was twice the risk of a short as with it free from earth, because in the first case it was only necessary for the insulation of one phase to break down for there to be a short, whereas in the second case it was necessary for the insulation of two phases to break down before there was a short-circuit. But it has been proved by experience that in an unearthed system, when the insulation of one phase breaks down it is very quickly followed by another, and so a short-circuit is established.

The voltage between any two phases is $\sqrt{3}$ times as much as that between one phase and the neutral point; it is clear, therefore, how much more disastrous must be the effect of a short between the phases than one between one phase and earth.

Shorts between phases are the faults on an unearthed system, shorts between one phase and earth being the usual faults on an earthed system.

Thus the conclusion was drawn that the neutral should be earthed at one point, and in order that the flow of current to a fault might be checked, a resistance should be inserted in the circuit.

Although it is now generally accepted that the neutral should be earthed at one point only and through resistance, yet there are still many central stations where a number of three-phase machines are run in parallel with all their star

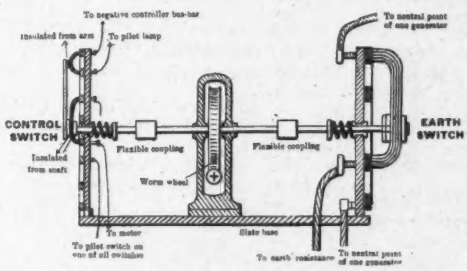


FIG. 1.—GENERAL ARRANGEMENT OF EARTH SWITCH.

points earthed; where this is done it is interesting to place an ammeter between the neutral point of each machine and earth.

The current flowing in the earth wire will be found to have a very variable wave form, and to have a periodicity of three times that of the system.

In one case which came under the writer's notice recently, the total current flowing in the earth bar of two 3,000-KW. generators supplying motors at 6,600 volts was 250 amperes. In this instance the neutral points of all the generators and motors on the system were coupled direct to earth. In another case, where a 1,500-KW. generator is run in parallel with a 3,000-KW. machine on a 6,600-volt system, and only the neutral points of the generators are earthed, the cross-current in the earth wire between these two machines often rises to 50 amperes.

It is obvious, therefore, that the ideal system is to have the neutral point of only one generator at a time connected through a resistance to earth.

This can be done by placing a knife switch in the earth wire of each machine, and having only one switch of those on the running machines closed at one time.

But in large power stations, where the switchgear is operated from a control desk placed on a gallery or perhaps in a switch room, this would not meet the case, for it would not coincide at all with the fundamentals of remote-control switchgear. Of course, remote-control switches to take the place of these knife switches might be installed, but an automatic device, such as that recently designed by the writer for use in conjunction with Westinghouse remote-control switchgear, seems to meet the case better.

Earth Switch.—This automatic earth switch is made up of two parts—the earth switch proper and the supplementary or motor-control switch by which it is operated (fig. 1).

The earth switch itself consists of a slate base on which are mounted one ring contact—which is connected direct to

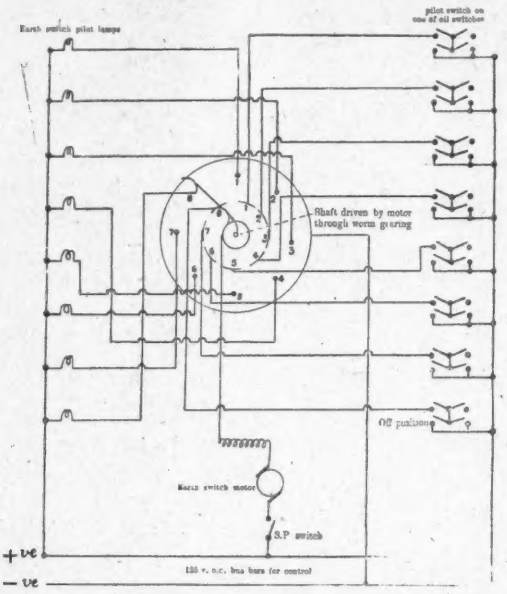


FIG. 2.—DETAILS OF CONNECTIONS OF MOTOR CONTROL SWITCH.

the earth resistance—and, concentrically with this, the same number of contacts as there are machines in the station, each of these contacts being connected to the neutral point of one machine (fig. 3). A brush carried on a shaft connects this ring to one contact at a time; this shaft is coupled by worm-gearing to a 1-H.P. motor, which is capable of revolving the brush at the rate of 2 R.P.M.

The supplementary switch is similar to the main switch, but is much lighter in construction; its revolving brush is carried on the same shaft as the main brush, and these two

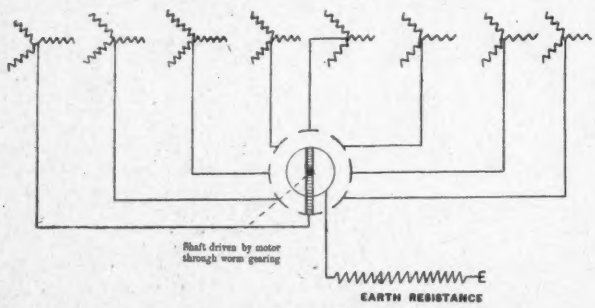


FIG. 3.—CONNECTIONS OF EARTH SWITCH.

brushes are on the opposite ends of the shaft, which is geared in the middle to the motor. The ring contact of this supplementary switch is connected to the negative side of the switch motor, and each of the small contacts corresponding to the neutral-point contacts on the earth switch, is connected to the "off position" of the pilot switch on the main oil switch for that generator (see fig. 2).

It will be seen from this sketch of the connections that while the earth switch is connecting the neutral point of a generator, which is switched on to the bus-bars, to earth, the motor circuit is broken at the pilot switch, but immediately the oil switch of this generator is opened the pilot switch comes over to the "off position" and closes the motor circuit. The motor then drives the revolving brushes until the main brush connects the neutral point of the next machine, which is switched on to the bus-bars, to earth. When it reaches this position, the brush on the supplementary switch being in a corresponding position, the motor circuit is now opened at the pilot switch on the oil switch of this generator. It is arranged for the earth switch to travel in a clockwise direction.

The small single-pole switch in the motor circuit is provided for opening this circuit when all the generators are off the bus-bars, so as to prevent the motor from driving the switch round and round, searching for a generator to earth.

In addition to this, on a particular switch designed by the writer, a pilot switch has been added similar in construction to the motor-control switch, the brush arm of this switch being likewise driven by the common shaft. This is shown in fig. 1, and the connections in fig. 2.

This pilot switch closes the circuit for the "earth-switch pilot lamp" corresponding to the generator which is earthed.

BUSINESS NOTES.

The Brussels Wiring Contract.—With reference to our paragraph on this subject last week, Messrs. Morrison and Roebuck, of Blackpool, now write:—"We notice that Mr. Maurice Closset, of Boul. du Hainaut, 93, Brussels, informs your readers that his firm had been entrusted with the whole of the work at the Alhambra Theatre, Brussels. We beg to contradict this, and to say that Mr. Maurice Closset's firm have only received the order for the following:—Stage and outside work, supplying, fixing and wiring switchboard, battens and float, and the outside lighting, as we could not get through the whole of the work in time for opening. The whole of the remaining electric lighting is being done by us."

Larkin' at Mammoth Fun City.—MESSRS. C. LARKINS & CO., electrical and general engineers and contractors, have secured the appointment as sole official contractors to the International Fairs, Ltd., Mammoth Fun City, to be held at Olympia, 1907-8.

Record Oil Separator.—MESSRS. HOLDEN & BROOKE, LTD., of Manchester, have recently received an order for one of their Brooke's patent "parallel flow" oil separators, which is to be capable of dealing with 178,000 lb. of exhaust steam per hour. So far as we are aware, this separator has a capacity of nearly double that of the largest hitherto on record.

Book Notices.—"Proceedings of the American Society of Mechanical Engineers." Vol. 29, No. 2. October, 1907. New York: The Society.

"Proceedings of the Incorporated Municipal Electrical Association." 1907. London: Wyman & Sons. Price 5s.

"Proceedings of the Institution of Electrical Engineers," Vol. 39, No. 186, September, 1907. Price 5s. Contents: Telephonic Transmission Measurements, by B. S. Cohen and G. M. Shepherd; Direct Current Design, by F. H. Page and F. J. Hiss; Hot-Wire Wattmeters and Oscillographs, by J. T. Irwin; New Type of Induction Motor, by L. J. Hunt, &c. Also Index to Vol. 39, and Articles of Association, with list of officers and members. London: E. and F. N. Spon.

"Proceedings of the Rugby Engineering Society." Session 1906-7. Vol. 4. Rugby: The Society. 1907. Price 10s. 6d.

"Chemical Trade Directory." 1907. London: Davis Bros. Price 10s.

"Introduction à l'étude de l'Electricité Statique et du Magnétisme." By E. Bichat and R. Blondlot. Paris: Gauthier Villars. 1907. Price 5 fr.

"The Socialist Spectre." By the Right Hon. Earl of Wemyss. London: Watts & Co. 1907. Price 1d.

"The Impossibility of Socialism." By Wm. Schofield. London: Watts & Co. Price 1d.

Catalogues and Lists.—MESSRS. JOHN SPENCER, LTD., Wednesbury.—Trade price list of wrought-iron tubes and fittings, also a revolving calendar disk for the years 1904 to 1925.

MR. JAMES LITTAUER, 72, Finsbury Pavement, London, E.C.—Advance sheets, illustrated and giving prices of lightning arresters, automatic controlling switch, double cells switches, moving-coil instruments, soft-iron instruments, switchboard instruments, also portable testing sets for any voltage up to 500 volts, and with a range of 0—5 megohms, as manufactured by Dr. Paul Meyer, A.G., of Berlin, for whom he acts as sole agent in the United Kingdom. Dr. Meyer makes a speciality of all kinds of switchboard work, and particularly of patent automatic battery switches for large capacities and high-tension work, and price lists can be obtained on application to Mr. Littauer.

MESSRS. CLARKE, CHAPMAN & CO., Victoria Works, Gateshead-on-Tyne.—This is a finely produced catalogue, using art-paper throughout, and very substantially bound. A number of views of the firm's winch machine shops, boiler shops, &c., lead off, and following these are given excellent half-tone illustrations, accompanied by brief descriptive particulars, of its winches and hoisting gear, windlasses, capstan gears, cranes, boilers of land, marine, and water-tube types, Woodeson's direct-acting steam pumps, mining power plant, of course including electrical and other manufactures. Two sections, one of 36, and the other of 73 pages, are devoted exclusively to electrical manufactures. The former includes views of, and data concerning, steam engines and dynamos, motors, and searchlight projectors; while the latter contains a fine collection of illustrations of the firm's electric capstans, overhead cranes, winches, drills, pumps, switchboards, &c. A tele-

graphic code occupies between 20 and 30 pages at the end of the volume. We have nothing but praise to accord to this excellent production, the perusal of which must leave on the mind of the user an impression of high-class manufacturing production.

Messrs. Ludw. Loewe & Co., Ltd., Farringdon Road, London, E.C.—Leaflet describing their cast-iron electric resistance grids, and stating in tabular form their dimensions, weights, electrical properties and prices.

Messrs. Isenthal & Co., 85, Mortimer Street, Cavendish Square, London, W.—Fully illustrated catalogue relating to their several types of mercury vapour lamps for wall, ceiling, shop window, workshop, and outdoor lighting service; also these lamps for series running on circuits up to 600 volts, with relay connections. A separate section of the list contains illustrated particulars of the Schott "Hg" lamps as arranged for use in photographic and other art studios. Prices are stated.

Messrs. Walter Locke & Co., Ltd., Calcutta.—Several specimens of their pamphlets relating to electric bells, telephones, heating and cooking apparatus, and ceiling fans.

We have received a copy of "The Insulator," a pamphlet periodically issued by Messrs. Pinchin, Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C., relating to their Standard varnishes for electrical use.

The Remote Control Switch Co., 5, Montpelier Street, Brompton Road, S.W.—Circular illustrating and giving particulars and prices of "Blackmore's" patent remote control switches.

Trade Announcements.—Messrs. T. Harding Churton and Co., of Atlas Works, Leeds, have appointed Mr. Cecil A. Esmarch, M.I.E.E., of 17, Collingwood Street, Newcastle-upon-Tyne, to be their agent in Newcastle and district for the sale of alternating current motors.

Mr. Brinley Rees has opened offices, as electrical and mechanical engineer, at Albert Chambers, High Street, Cardiff.

Messrs. Creightons, Ltd., of Carlisle, have appointed Messrs. Ward & Goldstone as their sole selling agents for electrical wood casing and troughing for south of Carlisle. Amongst numerous contracts secured by them for Messrs. Creighton is that for the casing for the Manchester New Royal Infirmary, which, we understand, is probably the largest institution in the world wired with casing, many miles of it having been installed at a cost exceeding four figures.

Messrs. Thermit, Ltd., have been appointed sole agents for Great Britain and Ireland for the sale of Messrs. Edgar Allen and Co.'s patent anchor grips. Samples can be inspected at their offices, 27, Martin's Lane, Cannon Street, E.C.

The Union Electric Co., Ltd., have appointed Messrs. Congdon & Co., of 5, Newton Street, Manchester, as agents for Lancashire and Cheshire for the sale of their dynamos, motors, switchgear, and measuring instruments.

Messrs. A. P. Wright & Co., electrical engineers, 60, Queen Victoria Street, E.C., are London district and shipping sellers of the patent high-speed self-lubricating paraffin oil engines that are made by Messrs. Belliss & Morcom, Ltd., of Birmingham. The firm have some of the engines on show at their showrooms in Union Street, Borough, S.E. We have received an illustrated specification showing the 4 and 6 and 8 and 10-h.p. sizes coupled to multipolar dynamos. The engines are stocked in sizes of from 4 to 12 h.p.

African Engineering says that Mr. William Blane, of Johannesburg, is about to retire from his business of consulting engineer, and has made arrangements to hand it over to Mr. H. Friedlander, his manager, and Mr. F. C. Sturrock, the electrical and mechanical engineer. The business will be carried on under the name of Friedlander, Sturrock & Co. at the same address—viz., 60-63, Permanent Buildings, Harrison Street, Johannesburg.

In the notice, which appeared on p. 607 of our last issue, of Messrs. Morris & Lister's new small knife switch, we omitted to mention that the London agents of the firm are Messrs. Frampton and Paine, of 29, Old Queen Street, S.W.

The London Shafting and Pulley Co. have removed to larger and more convenient premises situate at 26, Collingwood Street, Blackfriars Road, S.E., at the back of their old premises. They will now keep a larger and more varied stock of all ordinary pulleys and shaft fittings.

Messrs. J. R. Parkington & Co., electrical and general engineers, of 6, Prospect Place, Swansea, desire us to state that they are not connected with the new firm of How, Partington and Co., of Taff's Well, whose business arrangements were referred to on page 608 of last week's issue.

Bankruptcy Proceedings.—R. S. Blackburn, electrical engineer and contractor, Hebden Bridge.—October 31st is the last day for the receipt of proofs for intended dividend by the trustee, Mr. C. H. Plant, 14, Chapel Street, Preston.

For Sale.—The Co-operative Wholesale Society, Ltd., is offering for sale a number of steam and gas engines, dynamos, electric motors, cranes, &c. Full particulars appear among our advertisements to-day.

Natal Rubber.—According to Reuter, the first shipment of Tonga Land and Zululand rubber was dispatched to London on October 10th. A large tract of rubber country is being worked under a concession granted by the Natal Government, and regular shipments are expected.

Liquidations.—Kuettner, Macdonell & Cookson, Ltd.—A meeting is to be held on November 18th, at 19-21, Queen Victoria Street, E.C., to hear an account of the winding up from the liquidator (Mr. A. W. Sully).

Joseph Richmond & Co., Ltd., 30, Kirby Street, Hatton Garden, London.—On September 16th, Mr. R. J. Ward, 2, Clement's Inn, Strand, W.C., was appointed liquidator, with a committee of inspection.

Conduit and Insulation Co., Ltd.—The liquidator (Mr. Charles J. March) in his statement of affairs shows assets of £5,343, and liabilities amounting to £2,483, leaving a surplus of £2,860.

LIGHTING and POWER NOTES.

Barry.—An expert has interviewed a deputation of the U.D.C. and discussed the question of the lighting of the town by electricity.

Bolton.—The Electricity Committee has now completed arrangements for supplying energy to the extensive mills of Messrs. Ainsworth, cotton spinners, Great Lever. Many other textile firms in and around Bolton, are adopting electrical driving.

Brandon.—The U.D.C. has accepted the offer of Messrs. Pease & Partners, Ltd., for lighting the streets at Waterhouses by electricity, at £1 17s. 6d. per lamp per annum.

Bridge of Weir.—In connection with the Orphan Homes at Bridge of Weir, a complete new installation of electric lighting has been provided by two philanthropic individuals, at a cost of £4,000. Hitherto oil lamps had to be used in the houses as well as in the streets.

Burnley.—It is pointed out that our note last week regarding the Burnley Workhouse was misleading, as the electric light is already installed; the inquiry, we believe, is in respect of a supplementary supply for the Corporation mains.

California.—Our contemporary *L'Elettricista*, of Rome, publishes some important news concerning the construction of an electrical line 150 miles long, 50 miles of which is along the sea-coast of California, to be worked at a pressure of 100,000 volts. The installation is being constructed by the Stanislaus Electric Power Co.

Carlisle.—At a meeting of the T.C. on the 8th inst. the Electricity Committee reported the result of investigations into the management of the works, and intimated that they had received the resignations of the engineer (Mr. Burnett) and the assistant engineer (Mr. Scurfield). It was resolved that the resignations be accepted, to take effect as from March 31st, 1908. A member complained of the meagreness of the report, and asked for details; he moved that the sub-Committee's report be printed and sent to every member. After a long discussion, in which the town clerk stated that there was no report to print, the minutes were adopted.

Carmarthen.—The T.C. on October 9th gave its consent to the application of Messrs. J. B. Saunders & Co., of Cardiff, for a prov. order for E.L.

Coalisland (Co. Tyrone).—A movement is on foot in this town, which is a mining and weaving centre, for the introduction of an electric lighting scheme for the town and district. At a preliminary meeting last week, Messrs. Stewart submitted a scheme which was favourably received. The power is to hand in the river, which connects the local canal with Lough Neagh.

Douglas (Isle of Man).—The T.C. has appointed a committee to consider the advisability of establishing an electrical undertaking and the possibility of electricity being generated by turbine machinery in connection with the West Baldwin reservoir, or by waste water power elsewhere.

Eastbourne.—The T.C. has applied to the L.G.B. for a loan of £7,000 for mains, &c., for three years.

Epsom.—The U.D.C. has instructed the electrical engineer to report as to the cost of lighting the town by electricity as compared with gas.

Glasgow.—The Electricity Committee of the T.C. have refused to give active and financial support to the Exhibition to be held in Manchester next year by the National Electrical Manufacturers' Association, London.

The Secretary of State for Scotland has sanctioned the borrowing by the Corporation of £150,000 for the execution of capital works under the Glasgow Electric Lighting Order 1890 and the Burgh of Pollokshaws Electric Supply Order 1905, raising the total sum authorised to be borrowed for that purpose to £1,850,000. The Secretary for State adds in his letter that he hopes his suggestion as to increasing a provision made annually by way of sinking fund for redemption of the £885,000 borrowed prior to 1900 will be kept in view.

Gravesend.—The T.C., at a special meeting on the 14th inst., rescinded the resolution which it passed last June breaking the sealed contract to supply Northfleet with electricity. Northfleet demanded specific performance, and threatened Gravesend with a writ.

The opposition to Northfleet collapsed in quite a startling manner, only four members holding out against the rescission.

Failsworth.—The U.D.C. has decided to seek counsel's opinion upon the failure of the Manchester Corporation Electricity Committee to provide a supply of electricity for the district.

Handsworth.—The U.D.C. has decided to apply for loans of £18,200 for tramway feeders, and £1,756 for electricity supply purposes.

Heston and Isleworth.—The U.D.C. on Tuesday decided, in view of the business in charging accumulators having largely increased, to reduce the prices as follows:—10 amperes, 4d.; 20 amperes, 6d.; 40 amperes, 1s.; 60 amperes, 1s. 6d.; 80 amperes, 2s. In reply to a request from the Hounslow Ratepayers' Association, that an electric lighting expert should be engaged to advise the Council in its investigations into the working of the undertaking, the U.D.C. declined to take any further action to that already decided upon.

Liverpool.—At a meeting of the Select Vestry on Tuesday, a report on the result of the working of the electric generating plant which was installed at the Liverpool Workhouse, Brownlow Hill, a year ago was read, showing that a saving of over £1,200 had been effected as compared with the cost of working in an equal period with electricity taken from the Corporation at its regular scale charges.

Llandinam.—Through the energetic action of Mr. David Davies, M.P., the houses, churches, streets and railway station in this township are now electrically lighted. Two water turbo-generators, supplemented by an oil engine and dynamo, supply the energy at a cost of 1s. per annum per light to the inhabitants.

London. — Islington. — The Electric Lighting Committee report having received a communication from the electrical engineer dealing with the progress of the undertaking during the quarter ended June 30th last. The results are the most satisfactory that have yet been achieved. The Committee anticipates the increase in the total number of units sold during the 12 months to end March, 1908, will be three times as great as the increase in any previous year. As regards costs per unit, they were as follows during the quarter ended June, 1907, the figures for the corresponding period of 1906 being put in parenthesis:—Generation, 1·17d. (1·26d.); distribution, ·14d. (·21d.); rates and taxes, ·12d. (·17d.); establishment charges, ·35d. (·53d.); total, 1·78d. (2·17d.).

Lowestoft.—The T.C. has received from the L.G.B. sanction to loans of £6,250 for feeder cables; £5.000 for services and distributors; £1,500 for meters; £1,200 for public lighting; and £3,000 for motors.

Lytham.—The U.D.C. on October 10th sealed an agreement for the transfer of the E.L. order to the Local E.L. Co.

Partick.—At a meeting of the T.C., the engineer reported that the office staff and mains superintendent had refused to accede to the Council's decision as to their hours of work.

It was intimated that the Secretary for Scotland had consented to the borrowing of £10,555 by the Council to meet the cost of engine room extension, building for stores, &c., and for capital expenditure up to May last. The total sum authorised to be borrowed for works under the Partick Electric Lighting Order, 1893, is now £122,477.

South Africa.—East London.—A special meeting of the East London Town Council was held on September 17th to consider the question of reconstructing the power station, as recommended under two schemes, one by the town electrical engineer, and one by Messrs. Roberts & Long, of Durban and Cape Town respectively. The latter scheme involved an estimated expenditure of £35,000, and the construction of a new power station, and was lost by eight votes to two. The town electrical engineer's scheme for the alteration of the existing station at an estimated cost of £11,000 was also lost by the Mayor's casting vote. The reconstruction scheme is therefore shelved.

Uitenhage.—At a representative meeting of ratepayers, the principle of lighting the town by electricity was affirmed, and the electric lighting scheme of Messrs. Bellad, Ellis & Co., adopted by the T.C., was confirmed. Only 20 out of 600 present voted against the scheme.

Southampton.—The T.C. has decided not to obtain Parliamentary powers to carry on the work of free and assisted wiring.

Tunbridge Wells.—A L.G.B. inquiry was held on October 8th relative to the application of the T.C. for a loan of £9,000 for electricity purposes; there was no opposition.

Whitehaven.—The T.C. has decided to supply energy at 1d. per unit to electrical contractors for the purpose of displaying electrical appliances in their shop windows.

Willington.—The U.D.C. has asked the County of Durham Electrical Power Distribution Co., Ltd., to quote terms for the supply of energy for lighting purposes, with the use of overhead wires.

Wolverhampton.—The Corporation Electricity Committee has decided to extend the mains at a cost of £2,560 in order to supply power to the works of Messrs. J. Perks & Co., Commercial Road, and to the Chillington Tool Works, Willenhall Road.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The T.C. has agreed that from December 1st next the general manager of the tramways shall have charge of the whole of the Corporation tramway undertaking, with the exception of the permanent way and the overhead electric equipment and feeder cables.

Accrington.—There have been several cases before East Lancashire magistrates of late in regard to the obstruction of electric tramcars by drivers of various vehicles. The Accrington Bench on October 11th laid down the law very clearly. The clerk ruled that it was a driver's business to get out of the way of the car, and in giving their decision, the justices hold that the law appeared to be clear that tramcars were entitled to an unobstructed road.

Birmingham.—No sooner has the B. of T. inquiry into the tramway accident, which occurred on the 1st inst., been held, than the city is faced with another accident, though happily of less consequence. A car proceeding to Dudley, in passing over a section of the route which was under repair, left the metals and dropped into an excavation 2 ft. deep. Several people were slightly injured.

Continental Notes.—Italy.—A conference has recently been held at Marligni to discuss the project of constructing a railway between that town and Turin, in accordance with the terms of the concession granted to Eng. Butticag. The total length is 155 km., with a maximum gradient of 5 per cent. The conference approved the plans, and decided to proceed with the work, constructing the road to the normal gauge and operating it electrically.

Russia.—A double track electric railway is been constructed from St. Petersburg to Oranienbaum, and will be extended to Peterhof. Another line is projected to run from the capital into Finland, and the Kuliney waterfall will be drawn on for power.

Greece.—Work is now in hand for converting the tramways in Athens to electric traction. Several lines are expected to be completed early next year, while before the end of 1908 it is expected that 25 miles of electric tramways will be in operation.

Switzerland.—A concession has been granted to the Communes of Chiasso, Balerna, Coldrerio, Mendrisio, Capolago and Riva S. Vitale, for the construction of a narrow gauge electric tramway from Chiasso to Riva S. Vitale. The length of the line projected is 12,200 metres.—*Board of Trade Journal.*

Germany.—An electric tramway is about to be constructed between Solingen and Haan.

Glasgow.—The Tramways Committee has, in response to a request by the Amalgamated Society of Engineers, agreed to pay their repair squad, at Pinkston power station, double time for Sunday labour.

Halifax.—Four people were killed and thirty injured through a car running away on Tuesday morning. The car was proceeding from Sowerby Bridge to Halifax, when through some cause unexplained, it commenced to run backwards down Bolton Brow, finally leaving the track and being wrecked in a shop front. Most of the passengers took the conductor's advice and remained on the car; the conductor was killed.

Handsworth.—A loan of £2,896 for tramway purposes has been applied for by the U.D.C.

Ilford.—The Tramways Committee of the U.D.C. has obtained from the G.B. Co., the Traction Corporation, Ltd., and the Dolter Electric Traction Co. estimates of the cost of constructing the electric tramway from Cranbrook Road to Valentine's Gardens, on the surface-contact system. The estimates are as under:—G.B. system, tramway 1 and 1A, £8,737 6s. 4d.; tramway 2, £7,004 11s. 10d.; cost of equipment per car, £98 15s.; Traction Corporation, Ltd., 1 and 1A, £9,000; 2, £7,450; equipment per car, £30; Dolter Co., 1 and 1A, £9,319; 2, £7,523; equipment per car, £114. The surveyor's and electrical engineer's estimate for the overhead system was]: 1 and 1A, £7,500; 2, £6,300. The Committee decided to adopt the overhead system.

Kirkcaldy.—Mr. J. B. Hamilton (general manager, Leeds Corporation Tramways), who has acted as arbitrator between the T.C. and the Wemyss Tramway Co. in regard to the running powers of the latter over the Kirkcaldy system, has now reported on the matter, advocating the transposition of the termini of the upper and lower routes.

Llandudno.—The B. of T. has now passed the route between Llandudno and Rhos-on-Sea, and traffic will be commenced to-morrow. Arrangements are being made for extending the line to Colwyn Bay, and plans have been deposited with the latter Council, which desires to have all telephone and test cables laid underground, to utilise the standards for arc lighting and to make certain alterations in the proposed arrangement of the track.

London.—L.C.C.—It is recommended that Parliamentary powers be obtained for the construction of a line to link up the Streatham and Norbury lines. A portion of the line will be constructed on the overhead trolley system.

The short connecting line between Tooting Broadway and the London United Co.'s system, and the route to Tooting Junction, connecting to the South Metropolitan Co.'s Croydon line, have been inspected by the B. of T. and opened for traffic.

London.—L.C.C. Tramway Report.—A report on the working of the L.C.C. tramways during the year ended March 31st last was laid before the Council by the Highways Committee on Tuesday. From this it appears that the capital expenditure on the undertaking up to that date amounts to £6,946,310. The debt outstanding at the close of the year was £6,108,905. The receipts from the electric lines were £899,258, and from the horsed lines £585.345, or a total of £1,414,603. while the working expenses of the electric lines amounted to £478 418, and of the horsed lines to £596,697—a total of £1,075,116. There was, therefore. a surplus of £350,839 on the electric lines, a deficiency of £11,352 on the horsed lines, and a total surplus of £339,487. Against this for debt charges, income-tax, Parliamentary expenses, &c, is the sum of £329,813, leaving a net balance of £9,673. The balance brought forward on the appropriation account on April 1st, 1906, was £31,249, making the surplus revenue balance at the close of the year £40,923. Of this sum £35,000 has been transferred to the renewals reserve fund, increasing that fund to £141,855, the balance of £5,923 being carried forward. On the southern tramways during the year there was, after paying interest and sinking fund charges, a surplus of £93.259, which would have been sufficient to set aside £63,470 for renewals on the basis of 1d. per car-mile run, and to carry forward a balance of £29,789. This surplus is very nearly absorbed by the loss on working the northern tramways during reconstruction. The operating expenses were 7·06d. a car-mile run, as compared with 8·04d. a car-mile in 1905-6, the expenditure in connection with horse traction amounting to 10·33d. a car-mile run. The system has a total length of 116¾ street miles, including about 59 miles of electric tramways, of which about 28½ miles were opened in the course of the year. The number of passengers carried during the year was 314,227,090—183.062,063 by electric and 131.165,027 by horse traction, and the number of car-miles run was 30,130.297—16,267,579 by electric and 13.862,718 by horse traction. Of the total number of passengers 20·12 per cent. were carried at ½d. fares, and 62·29 per cent. at 1d. The total number of units generated up to March 31st, 1907, at the Greenwich generating station since its opening on May 26th, 1906, was 25,009,345, and the cost amounted to about ·676d. a unit, including interest and sinking fund charges.

The Finance Committee, reporting on the accounts, point out that the surplus for the year was £49.912 less than the estimate, this being accounted for mainly by the delay in starting the working under electric traction of the lines reconstructed during the year. From the figures the estimate of receipts—1s. a car-mile—adopted for the purpose of calculating the probable financial results of new tramway schemes appears to the Finance Committee to be justified. "It is obvious," concludes the Finance Committee, "that the results of 1906-7 have been adversely affected to a large extent by the work of reconstructing the northern lines, which was proceeding throughout the year, but there is every indication that when these lines are worked by electric traction satisfactory results may be expected. The question of the provision which should be made for future renewals when the period of reconstruction is over and electrical working has become generally established is engaging our attention, and we are in conference with the Highways Committee upon the subject."

Mexico.—A new electric tramway has just been inaugurated in the town of Guadalajara.

Richmond (Surrey).—The General Purposes Committee has reported that a system of tramways for Richmond and Barnes is feasible, and that a satisfactory scheme for connecting to Hammersmith Bridge can be arranged. It recommends the Council to approve the general principle, without committing itself as to the authority to work the system.

Soothill Nether.—The U.D.C. has sealed an agreement with the National Electric Construction Co. for the construction of that portion of the tramway from Dewsbury to Ossett which comes within the Council's area. It is anticipated that the line, which will link up the Dewsbury with the Wakefield system, will be completed by Whitsuntide.

United States.—New York.—The exposure of the financial misdoings in connection with the metropolitan tramways is proceeding, and it appears from what has already become known that the transactions which have taken place are of unique iniquity. Railways were bought at low prices and sold to the public at prices from 10 to 20 times their value. One financier received £100,000 for merely refraining from carrying out new enterprises. A non-existent railway was sold to the Metropolitan for £200,000. The cold-blooded villainy of the chief actors seems to be paralleled only by their ingenuity in evading exposure up to the present.

York.—At a meeting of the T.C. on the 14th inst., the Tramways Committee recommended that certain routes in the city should be constructed under a Light Railways Order, and that before exercising the powers a poll of the citizens should be taken to determine whether the Corporation should construct and work the tramways or lease the undertaking to a company. The estimated cost of laying down an overhead system, including the extension and adaption of the existing car-sheds, the provision of 20 cars, and the necessary street improvements, including the strengthening of Lendal Bridge, is £110,917; and (2) for laying down the tramways on a surface-contact system, including similar works and cars, £119,259, with rails of 100 lb. per lineal yard. Owing to the narrowness of several of the thoroughfares, it is suggested that the gauge should be 3 ft. 6 in. In moving the adoption of the report, Alderman Wragge said, to the costs given in the report would have to be added £11,000, the agreed amount for the purchase of the existing tramways. He pointed out the advantages of proceeding by Light Railway Order, and said it was proposed to obtain power to construct and lease the tramways, and then the Tramways Committee proposed to obtain offers from all electrical construction companies for the transfer of the powers, or for a lease for a period of years. This was agreed to.

TELEGRAPH and TELEPHONE NOTES.

Norway.—The telegraph system during 1905-6 increased from 9,734·5 km. of line and 19,351·3 km. of wire to 9,824·3 km. of line and 19,430·2 of wire, while the telephone system increased from 4,684·9 km. of line and 85,204·8 km. of wire to 4,941·7 km. of line and 87,967·3 km. of wire. The number of telegraph and telephone offices was also increased from 814 to 856.

The number of subscribers to the telephone system was 16,027 in 1904-5, of which Christiania claimed 12,549, and Trondhjem 1,954. These figures increased during 1905-6 to 16,487, of which 12,822 were at Christiania and 2,075 at Trondhjem. The total number of employés engaged in the two services, including those engaged in the erection and repairing of lines, was 3,000 in 1905-6.

Traffic on the telegraph system increased from 2,279,401 telegrams to 2,420,287, of which 1,445,772 were inland, 943,665 international, 384 transit and 30,466 free. There were also 53,487 meteorological telegrams, all of which showed an increase over the previous year.

According to the report most of the international traffic transited *vid* Christiania-Aberdeen, viz., 328,542 telegrams, the next highest number being claimed by the route *vid* Christiania-Hamburg, the Christiania-Sweden then following with 103,490. The largest number of messages was exchanged with Great Britain and Ireland, viz., 613,032, Germany being next with 424,100, Sweden with 234,608, Denmark with 193,240, France with 66,925, Holland with 51,111, and Belgium with 44,919 telegrams. To countries outside Europe there were 87,059 telegrams, 57,497 being for the United States and Canada. The number of service errors decreased from 504 to 296, and it was not possible to deliver 6,646 telegrams.

The number of conversations on the telephone system increased from 44,471,404 to 46,539,034, the majority of the 69,305 with international places being with Sweden and Denmark. The financial result has been correspondingly high, the receipts for 1904-5 being 4,545,698 fr. (about £181,828); and the figures for 1905-6, 4,856,263 fr. (about £194,251).

Expenses for 1904-5 amounted to 3,329,071 fr. (about £133,163); and for 1905-6, to 3,398,594 fr. (about £135,944), leaving a surplus of 1,216,627 fr. (about £48,665) in 1904-5, as compared with a surplus of 1,457,669 fr. (about £58,307) in 1905-6.

The private telephones in Norway were owned by 200 companies, with a *personnel* of 1,318, who dealt with 43,499,989 conversations, valued at 1,314,738 fr. (about £52,589).—*Journal Télégraphique.*

Telegraphic Interruptions and Repairs:—

	Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	.. Jan. 12, 1906 ..	..
Tarifa-Tangier		.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		.. Mar. 9, 1904 ..	..
Garachico-Santa Cruz		.. July 12, 1906 ..	..
Las Palmas-Arecife		.. Aug. 18, 1906 ..	..
Brest-Dakar		.. July 22, 1907 ..	..
Midway Island-Guam		.. Sept. 22, 1907 ..	
Sitka-Valdez		.. Oct. 8, 1907 ..	Oct. 9
Pernambuco-Ceara		.. Oct. 9, 1907 ..	..
Pernambuco-Para		.. Oct. 9, 1907 ..	..
Constantinople-Odessa		.. Oct. 10, 1907 ..	Oct. 11
	Landlines.		
Puerto-Barrios		.. Aug. 2, 1909 ..	..

Telegraphists' Strike in the U.S.A.—The result of a recent vote is a decision on the part of the operators to continue the strike.

Wireless Telegraphy.—The daily Press is still agog with excitement regarding the expected opening of the Marconi wireless trans-Atlantic service. This was looked for on Monday last, but has been postponed for a few days. As we go to press, we learn that the service was to be opened on Thursday morning (according to Mr. H. C. Hall), but Thursday afternoon at 2 p.m., according to M. Marconi, who is in Canada—that is to say, at about 7 p.m. by English time.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERDEEN.—Engine shed and other works at Ferryhill for Caledonian Railway. Company's engineer, Glasgow.

BANGOR (Co. Down).—New Technical Institute, in conjunction with Carnegie Library.

BELFAST.—Extensions and alterations to the Workhouse.

BIRSTALL (Yorks).—Central premises in Low Lane for the local Co-operative Society.

BLACKHEATH.—New Post Office. Secretary, H.M. Office of Works, Storey's Gate, S.W.

BOLTON.—Alterations and extensions to premises in Market and Hotel Streets for Beaty Bros., tailors.

BRADFORD.—New mill and warehouse in Longside Lane. J. Young & Co., architects, 62, Market Street, Bradford.

BRISTOL (Redfield).—New Mission Church (£2,000). H. V. Gough, architect; W. Cowlin & Son, builders, Shalton Street, Bristol.

(Longwells Green).—New church, "All Saints," (£3,408). Jacob Long & Son, builders, Railway Road, Bath.

BURNLEY.—Tramway offices in St. James's Street for the T.C. G. H. Pickles, borough engineer, Town Hall, Burnley.

BUSHEY (Herts).—Council offices, &c. Clerk to U.D.C.

CAMBORNE.—New County School for Girls. S. Hill, architect, Green Lane, Redruth.

CARDIFF.—New Catholic Schools at Nazareth House (£3,000 or £4,000). E. W. N. Corbett, architect, Cardiff.

CASTLETON (near Rochdale).—Ring spinning mill for the Cromer Spinning Co., Middleton.

New mill for the Ensoe Waste Spinning Co. (19,000 spindles).

CHESTER (Hoole).—New Council schools (£4,800).

CLECKHEATON.—Important additions to Scandinavia Mills. Howorth and Howorth, architects, Old Bank Chambers, Cleckheaton.

CONSETT.—Proposed new Roman Catholic church in connection with St. Mary's, Blackhill.

CORK.—Rebuilding premises of B. Haughton & Co., in North Main and Ryrl's Streets. W. H. Hill & Son, architects, 28, South Mall, Cork.

CREWE.—Nurses' Home for Railway Servants' Orphanage in Heathfield Avenue.

CWM (Mon.).—Schools, caretaker's house, &c., at Tallistown. H. Waters, Ebbw Vale, and S. Hutchins, Risca, architects.

DARLINGTON.—New science department at "Southend," Conisciffe Road. Clark & Moscrop, Darlington.

DARWEN.—Extensions to Britannia Mill for the Darwen Spinning Co.

DEVONPORT (Stoke).—Alterations and additions to 1 and 2, Tamar Terrace. Surveyor, Manor Offices, Devonport.

Extensive oil and petrol storage works with gantries, travelling cranes, &c., for the Admiralty.

DONCASTER.—New banking premises in St. Sepulchre Gate. Barclay & Co., owners.

DOUGLAS.—Business premises on Central Promenade. Palace and Derby Castle Co., Ltd., owners.

Houses (15), Queen's Promenade. Alex. Gill, builder, Douglas.

DOVER.—New Fort at the Admiralty Pier. W. P. Goose & Sons, builders, 124, Milton Road, Gravesend.

DOWLAIS.—Extensive additions to ironworks for Guest, Keen, & Nettlefolds, Ltd.

DUNDEE.—Alteration to workshop for J. Durham & Sons.

EASTBOURNE.—Business premises. D. Dendy, 3, Church Street, Old Town Eastbourne, owner.

EBBW VALE (Mon.).—New Congregational Church Sunday Schools. T. Roderick, architect, Ebbw Vale.

EVESHAM.—Extensions to the Workhouse. Espley & Co., builders, Evesham.

FORFAR.—Extension of Wellbrachead School. School Board Clerk of Works, Forfar.

GOSPORT.—Institute in connection with Christ Church (£2,000).

HALIFAX.—Extensions at Ladyship Mills. J. F. Walsh & G. Nicholas, architects, Museum Chambers, Halifax.

New brass foundry in Spring Hall Lane. Thos. Kershaw, architect, L. & Y. Bank Chambers, Halifax.

HAMPTON.—Additions to workhouse (£700). G. H. Hunt, 26, Bedford Row, W.C., architect.

HEMEL HEMPSTEAD.—Additions to Frogmore Mills for the British Paper Co.

HARLESDEN.—Central fire station (£10,585). O. C. Robson, surveyor to Willesden U.D.C., Dyne Road, Kilburn, N.W.

HUDDERSFIELD (Lepton).—New mill at Whitley Willow. J. Berry, architect, 2, Market Place, Huddersfield.

HYTHE (Kent).—Ad ons to Ursuline Convent, Seabrook Road.

Block of shops in High Street. Mr. Straughan, owner, Seabrook, Hythe.

ILFORD (Essex).—Alterations to Red Lion public house for Watney, Coombe, Reid & Co., Stag Brewery, Pimlico.

JARROW-ON-TYNE.—Parish hall. Hicks & Charlewood, architects, Newcastle-on-Tyne.

KEIGHLEY.—Alterations and additions to infirmary for the Board of Guardians.

KINROSS.—New premises for Kinross-shire Savings Bank.

KNUTSFORD (Plumbley).—New ammonia soda works to be established.

LEEDS.—Extensions to "Tower Works" for Harding, Richardson & Rhodes, Ltd. W. Bakewell, architect, 38, Park Square, Leeds.

LEICESTER.—Extensive business premises corner of Horsefair Street and Hotel Street. Morgan, Squire & Co., drapers, owners.

LINCOLN Rampton).—New prison to be erected by the Prison Commissioners.

LLANFAIRFECHAN (Carnarvonshire).—Residence on the Bryn-y-Neuadd estate for the governors of St. Andrew's Hospital, Northampton. C. H. Dorman, architect, 53, Abington Street, Northampton.

LONDON.—(Wandsworth).—School in Merton Road, to accommodate 1,116 children. T. J. Bailey, architect to Education Department of L.C.C., Spring Gardens, S.W.

(Kensington).—Building at corner of High Street and Hornton Street for the Capital and Counties Bank head office, 39, Threadneedle Street, E.C.

(W.C.)—Extensive premises at corner of Hampstead Road and Euston Road, for London and Westminster Bank. Howell J. Williams, 11-17, Bermondsey Street, London Bridge, S.E., builder.

(Oxford Street).—Buildings on sites of Nos. 25, 27 and 35. Phillips, Phillips & Co., 6, Newman Street, Oxford Street, W., agents.

(Mayfair).—Extensive alterations to 63, Brook Street. G. T. Hine, 35, Parliament Street, S.W., architect.

(Bond Street, W.).—Alterations to shop (No. 15B). J. R. Lang and Son, 35, Compton Street, Clerkenwell, builders.

(Shoreditch).—Laundry and other buildings attached to workhouse. Robert Clay, clerk to the Guardians, 213, Kingsland Road, N.E.

(Brondesbury Park).—36 houses. Callow & Wright, Brondesbury Park, builders.

(Hammersmith).—Building in Great Church Lane, for J. Lyons and Co., Ltd., Cadby Hall, Kensington, W.

(Putney). — Rebuilding premises in High Street, for Boots, druggists. Rice & Son, 45, Stockwell Road, Clapham, S.W., builders.

(Lewisham).—Electric equipment, including 20-H.P. motor, for the Workhouse laundry. H. C. Mott, clerk, 394, High Street, Lewisham, S.E.

(St. Andrews Street, E.C.).—Alterations to St. Andrews House. Harrison & Spooner, 26, College Street, Dowgate Hill, E.C., builders.

(Islington).—Buildings in Tollington Park and Pine Grove. E. D. Hoyland, 2, Walbrook, E.C., architect.

LONDON.—(Deptford).—Re-erection of Watermen's Arms public house, for Mann, Crossman & Paulin, Ltd. W. Stewart, 4-5, Aldgate High Street, E., architect.

(Kilburn).—Station at Salusbury Road, for North London Railway Co.

MANCHESTER.—United Methodist Church in Dickinson Road. Sankey and Cubbin, architects, Chapel Walk, Manchester.

Additions to the Workhouse to accommodate 500 inmates for the B.G.

Paving material works at Trafford Park. R. L. Lawe, Worsley Road, Farnworth, Bolton.

MANSFIELD.—New Post Office.

MELTON MOWBRAY.—Important additions to Hamilton Lodge. Lord Hamilton of Dalzell, owner.

NAIRN.—Villa on Firhall Lands for J. Buchan. J. Squair, architect, 35, Queen's Gate, Inverness.

NEWPORT, ESSEX (Quendon).—Extensive additions to Quendon Hall for W. Foote Mitchell. J. H. Spamis, Newport, Essex, builder.

OXFORD.—Extensions at St. John's Home and Hospital. Benfield & Loxley, builders, Bullingdon Road, Oxford.

New Church, St. Andrew's. A. R. G. Fenning, architect; Dove Bros., Ltd., builders, 4, Tokenhouse Buildings, London.

PAR (Cornwall).—Offices, &c., for C. E. Treffry, Fowey. J. Multon, Charlestown, St. Austell.

PENZANCE.—New Parish Hall for St. John's Parish (£1,000). O. Caldwell, architect, Penzance.

PERTH.—New premises for D. Reid, Hammerman Inn (£7,000). J. W. Smart, architect, Perth.

Large Hall to hold 2,500 people, and small Hall for 500, for Corporation (£25,000). Mr. Burnett, architect, Glasgow, assessor on plans.

PENTRE (Rhondda).—Business premises for Jones & Devonald. W. D. Morgan, architect, Post Office Chambers, Pentre, Rhondda.

PORTH (Glam.).—Metal workshop at Porth County School. J. Rees, architect, Hillside Cottage, Pentre, Rhondda.

RICHMOND-ON-THAMES.—Important additions to old Court House, Richmond Green. W. J. and A. Long, builders, 17, Sheen Road, Richmond-on-Thames.

ROCHESTER.—E.L. installation at the Old Corn Exchange for the T.C.

ROTHBURY.—Proposed new parish hall.

ST. ALBANS.—Detached houses in Clarence Road. J. Elwood, owner.

ST. ANNES-ON-SEA (Lancs.).—Extensions to Ormerod Homes, Clifton Drive North.

SALFORD (Broughton).—E.L. installation at the Town Hall. Salford Borough Electrical Engineer, Frederick Road Works, Pendleton.

SOUTHAMPTON.—Enlargement of the Post Office. Secretary, H.M. Office of Works, Storey's Gate, S.W.

STAFFORD.—Important extension of works and new manager's residence. Siemens Bros.' Dynamos Works Co., Ltd., owners.

STOCKPORT.—New tramway offices for the T.C. (£2,500). Geoffrey Brady, architect, Stockport.

STOKE-ON-TRENT (Smallthorne).—New factory and extensions to the present works at Milton, for the British Aluminium Co.

STOURBRIDGE.—Extensions to Free Library in Hagley Road. F. Woodward, architect, Town Hall, Stourbridge.

SUNDERLAND (Seaham).—New lifeboat house. W. T. Douglass, consulting engineer, 15, Victoria Street, Westminster, S.W.

Important additions to Walton's Hotel, including buffet, warehouse, and three shops. Laing & Co., Sunderland, owners.

(Pallion).—New United Methodist Church (nearly £3,000). H. Barnes & C. F. Burton, architects, Newcastle and West Hartlepool; J. W. White, builder, High Barnes Works, Sunderland.

SWANAGE.—Important extensions to the Parish Church (£4,700). J. E. Clifton and E. A. Robinson, architects; H. and J. Hardy, builders, Gilbert Works, Swanage.

TEDWORTH (Wilts.).—Wesleyan Church and Institute.

TUNSTALL (Staffs).—E.L. installation in Town Buildings for the U.D.C. A. R. Wood, surveyor to the U.D.C., Tunstall.

TWICKENHAM.—New Infectious Diseases Hospital. F. W. Pearce, surveyor to the U.D.C., Town Hall, Twickenham.

VENTNOR (Isle of Wight).—Extensions to the Wesleyan Church (£1,121). Albert Sims, builder, High Street, Ventnor.

WAKEFIELD (Hemsworth Collieries).—Three shops and houses, slaughterhouse and out-offices for the South Kirby, Featherstone and Hemsworth Collieries, Ltd. Garside & Pennington, architects, Pontefract and Castleford.

WALLINGFORD (Berks.).—New elementary school (£3,000) for the T.C.

New fire station for the T.C.

WALNEY.—New Parish Church. Austin & Paley, architects, Lancaster.

WANSTEAD (Essex).—New Sunday schools and parish hall (£1,882). Church, Deakin & Cameron, architects, Devonshire Square, London; Osborne & Sons, builders, Woodford, Essex.

WARWICK (Hatton Junction).—Establishment of garden city, with church, hotel, institute and 71 detached villa residences. C. E. Trafford, promoter, resides near Norwich.

WAVERTREE (Liverpool).—New church in Ashfield, "St. Thomas's." Architect, R. Wynn Owen, Castle Street, Liverpool.

WIGAN (Standish).—New Roman Catholic Presbytery and Club. Father Walmesley.

WILLESDEN GREEN.—Extension to Baptist Schools, Huddlestone Road.

WITHINGTON.—Proposed new Congregational Schools, Palatine Road.

Sunderland Tramways—A Disclaimer.—Regarding the leader in our last issue on "The Sunderland Tramway Accidents," the general manager and engineer of the Sunderland Corporation Tramways, Mr. A. R. Dayson, writes to point out that no accident of the kind in question has ever occurred at Sunderland; the accidents referred to took place at Silksworth, 6 or 7 miles from Sunderland, on a system which has no connection whatever with Sunderland, and does not run into the borough.

We have pleasure in publishing this statement, in justice to the excellent reputation of the Corporation tramway system; it did not occur to us at the time of writing that the misfortunes of the Sunderland District Electric Tramways might erroneously be attributed to the former undertaking.

ERNST DANIELSON.

By the death of Ernst Danielson, the Swedish engineers have lost one of their most prominent members. Although he had scarcely attained middle age, Danielson had done more to further engineering knowledge than is generally possible for a man during a long life. Modern electro-technical science has lost one of its pioneers, as his name was well known and his work appreciated far beyond the frontiers of Sweden and of Europe.

Danielson was born on January 19th, 1866, in Voxna, and after having studied at Upsala he was, in 1883, admitted as apprentice at the Arboga Works of the Stockholm Electrical Co. In 1884 he entered the Technical High School in Stockholm, where he passed his final examinations in 1887, and from there returned to the Arboga Works. During 1888 he experimented in Norrkoping with a method of electrical tanning, and after these experiments were concluded he was appointed assistant engineer to the Electrical Co., with whom he stayed until 1890, when he went to the United States. There he first accepted a position with the Wenström Consolidated Dynamo and Motor Co., of Baltimore, and afterwards with the Thomson-Houston Co., of Lynn, Massachusetts, which a short time later was consolidated with the Edison Co., of Schenectady, forming the present General Electric Co. of America. While with the Thomson-Houston Co., Danielson carried out a large amount of exceedingly responsible work. In 1892 Danielson was offered the position of chief engineer, by the Allmanna Svenska Elektriska Aktiebolaget, of Westeras, Sweden. Before entering upon the duties of this position, he, during the summer of 1892, visited works in England, France, Switzerland and Germany. In April, 1895, Danielson left the Allmanna Svenska Elektriska Aktiebolaget, of Sweden, in order to enter upon a consulting engineering practice in Stockholm. Here, among other important undertakings, he prepared, at the request of Dr. de Laval, proposals for utilising the water power of the Trollhättan Falls. During the winter of 1897-8, Danielson again visited America, and on his return visited most of the prominent electrical installations in Switzerland and Italy. In 1900 he was appointed to the position of Technical Director of the Allmanna Svenska Elektriska Aktiebolaget, of Westeras, Sweden, and occupied this position until 1903, when it became necessary, owing to his failing health, to delegate most of his work to others. The last years of his life were spent partly in the country, and the last two winters in Teneriffe and Mentone, where it was hoped that he would benefit from the mild climate.

Ernst Danielson, M.I.E.E.

While living in Stockholm, Danielson was for some time chairman of the Swedish Institution of Civil Engineers (Svenska Teknologföreninger). In 1906 he was elected a member of the Royal Academy of Science; he was also a member of the Institution of Electrical Engineers of Great Britain, and of the American Institute of Electrical Engineers.

Danielson's most important pioneer work consists of his researches in the three-phase system, and its utilisation for power transmissions. Having studied Wenström's inventions — which at that time, however, had not been put into practical shape —Danielson, as already stated, went to the United States During his two years' stay in America he had exceptional opportunities for making exhaustive practical tests with the three-phase system, and at this early date he became convinced of its practical importance. At this time (1890) only very meagre results had been achieved in Sweden with the Wenström three-phase system. On his return from America, Danielson devoted considerable attention to the design and development of lines of thoroughly satisfactory three-phase apparatus. After a comparatively short period, during which time he had worked extremely hard, the first machines were completed and were found to fully realise all expectations. On the basis of experiments with these machines, the theory was now still further developed, and in this connection, Danielson drew up his plans for the use of the three-phase system for electric power transmission on a considerable scale. The first work to be carried out was the well-known Hellsjön-Grängesberg power transmission, the success of which led to several other power schemes, such as Hofors, Boxholm, &c.

During 1892 and 1893, when he was planning these installations and designing the machinery to be em-

ployed, theories for this type of machine were not altogether wanting in foreign countries. These theories had received, however, but little practical confirmation, and Danielson's installations were in reality pioneering work, when due regard is paid to the size of the whole installations as well as of the individual machines, and above all to the good results which were obtained. It is probably a rare occurrence that installations so novel in all details, and carried out on such a large scale as those above mentioned, should work in such a satisfactory manner from the very start, and the fact that, after the lapse of 12 to 14 years which have been characterised by enormous developments in electrical science, these pioneer installations of Danielson's are still working, bears striking testimony to his engineering judgment and ability.

Apart from the value of Danielson's theoretical contributions to the development of the three-phase theory, one must not forget the importance of the fact that Sweden has by this means come into a position to utilise the national wealth represented in its water power, at an earlier date than would otherwise have been the case, and thus the product of the Swedish electrical industry has been enabled to take up a prominent position in the international market.

Danielson's electrical researches did not end with the three-phase system and its developments. On account of his position and of his interest in all branches of science, he had opportunities to devote himself to other branches of electrical development, in which he accomplished valuable theoretical and practical work. During recent years he devoted himself mainly to the development of the theory of the single-phase motor, and the investigations which he published constitute very important contributions to progress in single-phase motors.

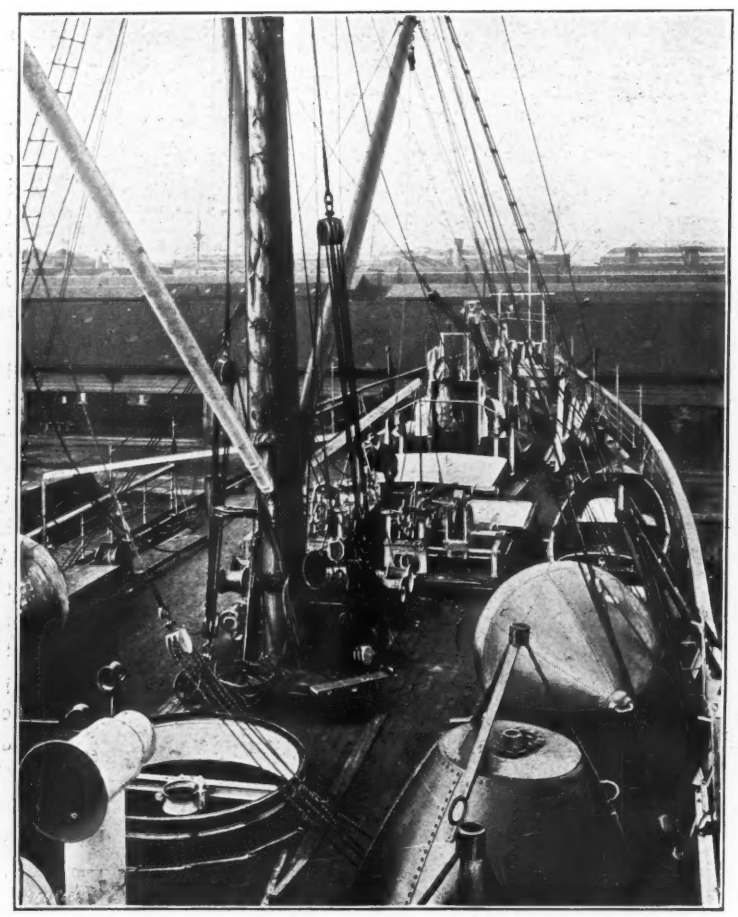
Amongst the numerous papers in which Danielson recorded results of his work, may be mentioned the following :—

"Reversibility of Three-Phase Motors." *Electrical World*, 1893.
"Electrical Power Transmission." *Hellsjön-Grangesberg*, *Teknisk-Tidskrift*, 1894.
"Graphic Theory for the Calculations of Inductive Polyphase Motors." Awarded the Polhem prize and published in *Teknisk-Tidskrift*, 1895.
Several papers dealing with electrically-operated rolling mills and winding engines. Published in *Teknisk-Tidskrift* and in other papers.
"Kaskadenschaltungen bei Motoren für Walzwerke." *Elektrotechnische Zeitschrift*, 1903.
"Theory of the Compensated Repulsion Motor." Transactions of the International Electrical Congress, St. Louis, 1904.

Though his main work relates to electrotechnical science, Danielson was thoroughly at home in several other branches of engineering science, and took a considerable interest in the utilisation of electricity in other technical branches. As an instance may be mentioned that, with his considerable knowledge of turbines and machinery for the utilisation of water power, it was possible for him to clearly realise the features which are necessary for hydro-electrical installations, and his knowledge of rolling-mill and of mining machinery enabled him to clearly appreciate the requirements to be met by electric motors for this kind of work. It is largely on account of this many-sidedness in technical knowledge, during a time when the electrical science was rapidly developing, that Danielson's work has been of such great value. Those who knew him personally will always remember him as a kind and true friend.—[From the *Teknisk Tidskrift*, August 24th, 1907.]

THE NEW CABLE STEAMER "GUARDIAN."

Through the courtesy of Messrs. Johnson & Phillips, Ltd., who have supplied the cable equipment of the new cable steamer *Guardian*, we are enabled to give some interesting details of the ship.



The Cable Steamer "Guardian." View Forward of the Bridge Deck.

The vessel was built by Messrs. Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, for the Central and South American Telegraph Co., the cable machinery being fitted under the supervision of Mr. J. S. Bonnyman, consulting engineer, on behalf of Messrs. Glover Bros., of London, who have acted for the owners.

The ship, which is 270 ft. long and has a beam of 36 ft., is provided with twin screws and two sets of triple-expansion engines, supplied with steam from two single-ended marine boilers working with Howden's system of forced draught.

The total deadweight capacity of the vessel is made up as follows :—Coal, 700 tons ; cable, 665 tons ; cable machinery, 50 tons ; cable stores, 60 tons ; fresh water and provisions, 100 tons ; spare gear, 15 tons ; and a balance of 160 tons for stores, refrigerating plant, &c., making a total of 1,750 tons.

The contract speed of the ship was 12½ knots, but she is capable of greater speed, as proved by her trials.

The vessel is provided with 4 cable tanks of different sizes ; the two largest have inner tanks for different size cables.

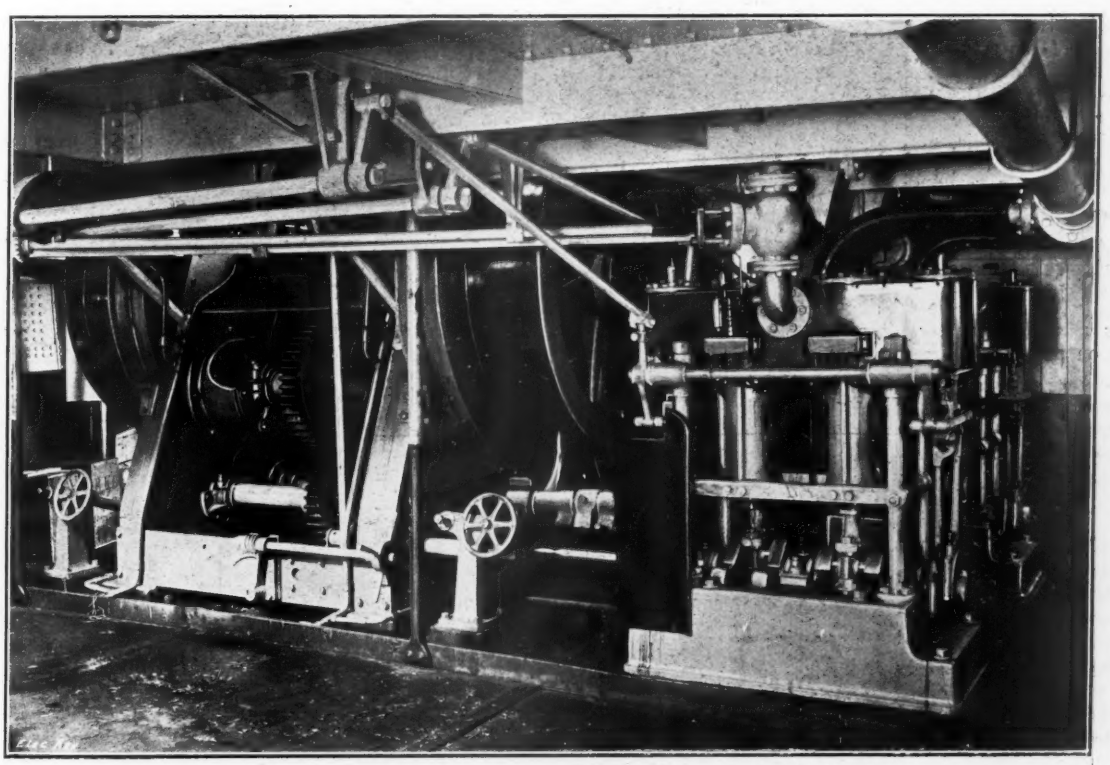
Each tank has an inner cone, and one of these is used for fresh water, which, together with that contained in a tank formed by the enclosure between the bulkheads of the two shaft tunnels, provides an ample store for the ship.

A dynamo in the main engine room supplies electric light to the whole ship, and is also employed for the searchlight on the bridge, which is required for looking out for cable buoys and marks at night.

On page 650 we give a general view of the spar deck, looking forward from the bridge deck; the powerful picking-up and paying-out machine is fixed on the main deck, and the drums can be seen projecting above the hatch in the spar deck. This gear is Messrs. Johnson & Phillips's improved type, and is what is known as a double combined picking-up and paying-out machine. It can be seen in greater detail below.

In consultation with the owners' agents and the shipbuilders, Messrs. Johnson & Phillips have arranged the engines on the starboard side of the machinery, the usual practice being to have one engine at each end, fore and aft. The present arrangement is found to be an advantage over the old one, as it leaves more space for getting at the working parts of the machine.

The two engines are each of the double-cylinder high-pressure type, with cylinders 8 in. diameter and 8 in. stroke. Each engine will develop 110 B.H.P. with a steam pressure of 150 lb., or a total of 220 B.H.P., which may be utilised to drive one or both machines.



The Cable Ship "Guardian"; Picking-up and Paying-out Machinery.

Owing to the necessity of starting under heavy loads, this type of engine is supplied in preference to the compound type, the small advantage in steam consumption of the latter being outweighed by the additional starting power of the former.

The gear has been designed so that either engine will work each or both machines in a forward or reverse direction, and the power of both the engines can be combined to drive either one or both machines in either direction; with the gear so arranged, the risk of a total breakdown is reduced to a minimum.

With the two engines in gear, the picking-up machine will haul in cable against a strain of 25 tons at 1 knot, or 10 tons at $2\frac{1}{2}$ knots; the paying-out machine will lift 10 tons at $2\frac{1}{2}$ knots, or $6\frac{1}{4}$ tons at 4 knots.

Each machine, through reduction gear, can be driven at a higher or lower rate of speed, and a sliding gear wheel is provided on an intermediate shaft, by which the two systems can be connected together, so that either engine can drive either drum through any of the four different gears.

The cable drums are made to overhang and run loose on their shafts; each is driven by a sliding pinion, gearing into an internal gear ring attached to the drum.

As the brake ring is attached to the drum, it is only necessary to have the drum and holding-back gear running when paying-out, thus saving the wear and tear of the whole machine, and avoiding the noise and rattle of the gearing.

Another advantage in this arrangement is that the drum shaft, being fixed, acts as a tie and greatly strengthens the frame; and similarly the shaft which carries the intermediate wheel for coupling the two systems together acts as a tie.

The position of the internal gear rings on the drums, allows of the pinion shafts being supported by outer bearings—a point of great importance, since the provision of the sliding pinion prevents the inner bearing being close up to the pinion when in the driving position.

The main brakes consist of steel straps lined with elm blocks encircling the brake ring, on which they are made to close by means of a double-threaded screw actuated by a hand-wheel through the medium of a worm gear, which gives a very fine regulation for the lighter strains, and at the same time provides enormous holding power when necessary.

To the back of each strap is fitted a water service pipe, the water, supplied by a Worthington pump, being directed by nozzles between the joints of the brake blocks and on to the face of the drums.

By means of Johnson & Phillips's arrangement of the gear, both brakes can be combined to act on one drum, when necessary, to give extra holding-back power.

All the gearing is of cast-steel. The "hauling-off" and "holding-back" gears are mounted on the spar deck, and are each driven by a silent saw-tooth chain from a shaft carrying a pinion, which can be made to slide into engagement with the internal gear ring on one of the main drums.

They are provided with a friction brake and "free wheel" arrangement, so that they are driven in one direction only, *i.e.*, the picking-up direction, then revolving with a slightly higher peripheral speed than the main drum, and thus keeping the cable tight.

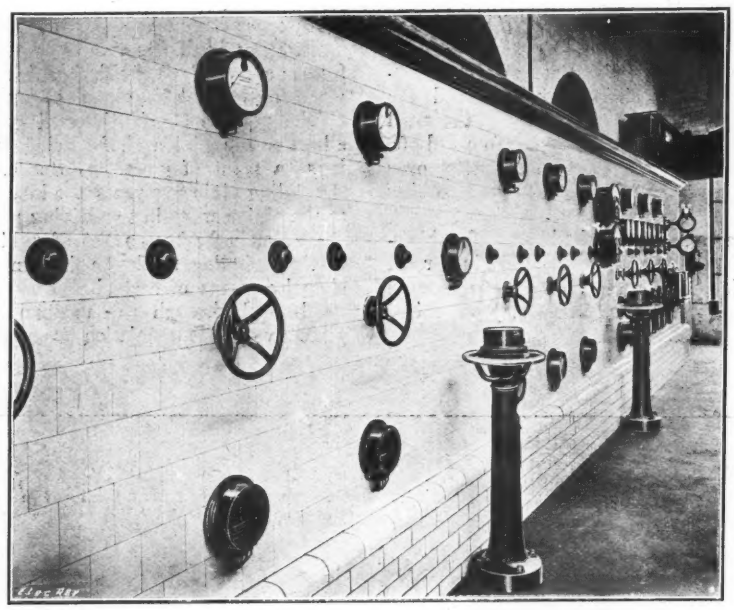
When paying-out, however, they are held back by the

brake, and allowed by the "free wheel" to revolve with a slower peripheral speed than that of the main drum.

When, therefore, it is necessary on a picking-up job to reverse and pay out a little slack, the gear acts quite automatically. This is a great advantage over the older system, where it was necessary to put a clutch in and out of gear.

A screw gear is also provided for traversing the haul-off sheave across the face of the drum to suit either "inside" or "outside" lead, and this can be worked while the machine is running.

Practically the whole of the actuating gear is operated from the spar deck; the main brake wheels, steam stop valves, engine reversing gear and drain cock handles are all within reach from one position.



Lindal Moor Mines: View on the Switch-Gallery. (See p. 653.)

The hand-wheels for putting the various gears into action are all close by, as well as the levers for putting into action and regulating the hauling-off gear, and it is only necessary to go below to couple the two engines or to adjust the fleeting knives when the cable is being first passed round the drums.

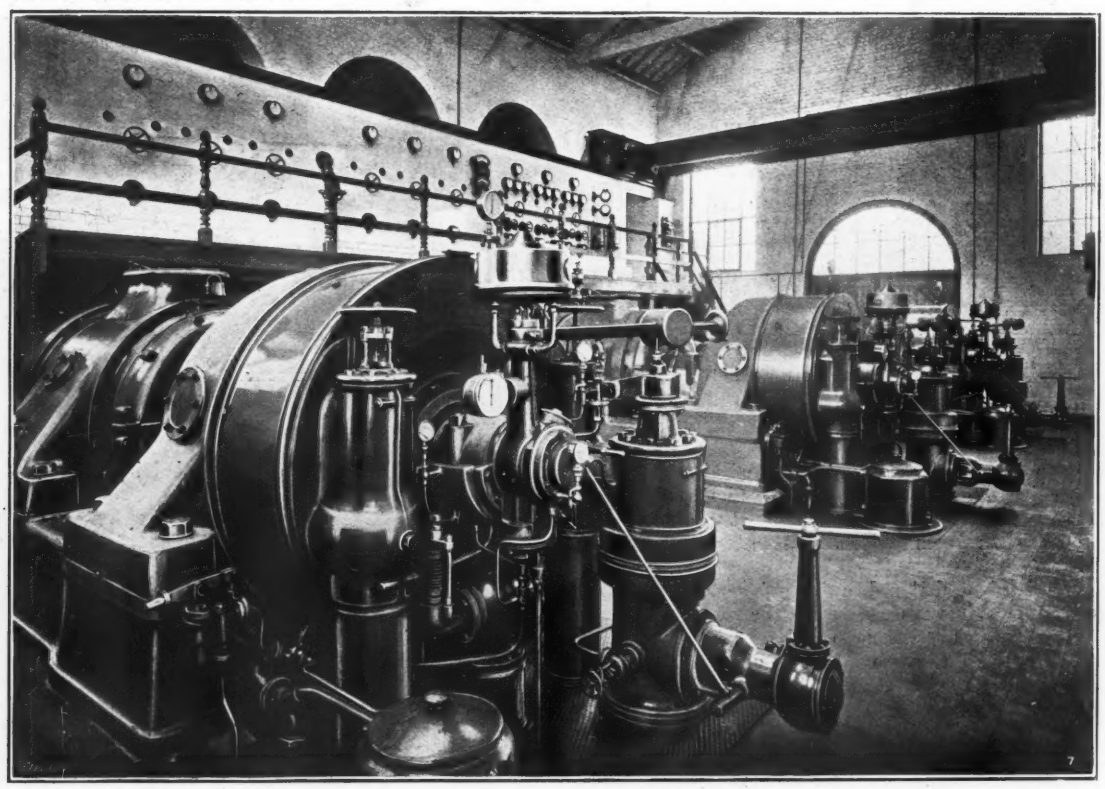
The gear was tested under steam at Messrs. Johnson and Phillips's works before delivery, and after erection on board it was put through exhaustive tests to the satisfaction of all concerned.

In addition to the machine described above, Messrs. Johnson and Phillips have supplied a steam hauling gear for putting cable into the tanks, a steam sounding machine and their improved dynamometers, two of which are placed forward and one aft.

The dynamometers at the bow will register from a delicate strain on the cable of 6 or 7 cwt. to a heavy strain of 25 tons, while the stern dynamometer will register from 5 cwt. to 10 tons.

There are three bow sheaves, 4 ft. 3 in. dia. over flanges, each of which is fitted with cast-iron guards; and one sheave wheel at the stern, 3 ft. 3 in. dia., provided with similar arrangements to the bow gear.

Messrs. Johnson & Phillips have also supplied a full equipment of all the necessary accessories and stores, comprising buoys, mushrooms, grapnels, chains, sounding gear, lamps, &c.



General View of the Power Plant, Lindal Moor Mines, showing the A.E.G Turbo-generators, &c. (See p. 653.)

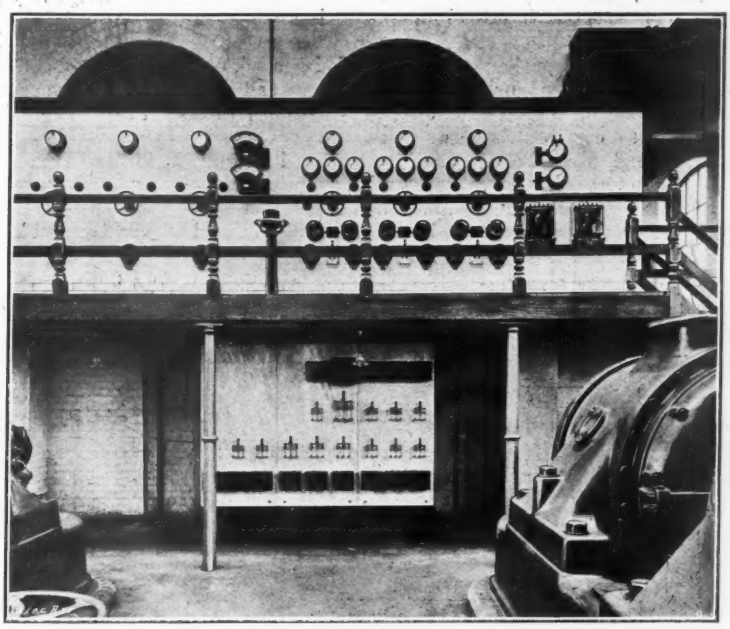
A telephone service is provided by which the captain and the electrician can communicate with the engine room or elsewhere.

The *Guardian* sailed from London on October 5th, her destination being Callao, which is to be her port of call. She is commissioned for three years, during which time she will be occupied in laying and repairing the cables of the company's system on the Western American coast.

ELECTRICAL PUMPING AT LINDAL MOOR MINES.

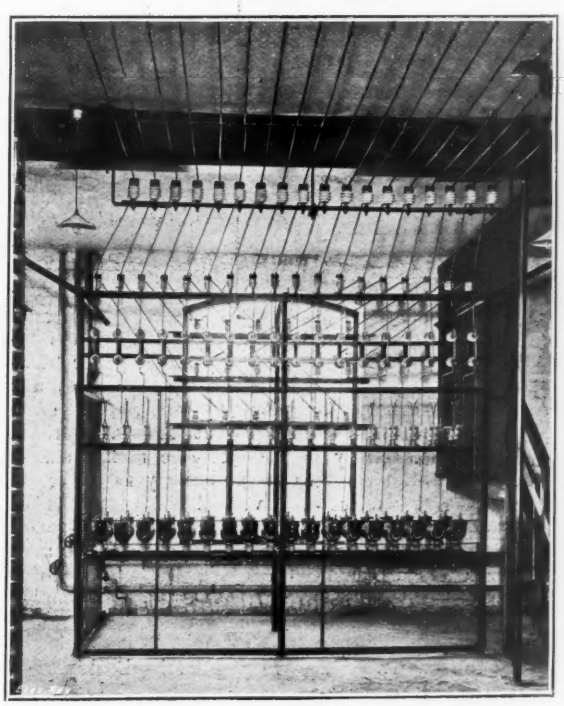
Although there exists some literature on electricity as applied to mining, the important function of electrical pumping is in many cases dismissed in a few lines, and yet this is one of the easiest and at the same time most useful mining operations to which electricity can be applied. That so little is published concerning electrical mine pumping is all the more extraordinary when we consider the large number of pumping plants already installed. There is no application of electricity to mines where better results have been obtained than with the working of pumps, results, indeed, unattainable by any other method of transmission, because of the steady load on the motor.

Pumps electrically driven have also had a limited application for the purpose of unwatering mines, for which they are eminently suited owing to the great advantage of their remarkable portability, and it was to witness an electrical pumping installation in operation at Lindal, near Ulverston, that we, in company with other Press representatives and gentlemen financially or otherwise interested in the matter, were invited by Messrs. Harrison, Ainslie & Co., Ltd., to visit their hematite iron ore mines in the district on Thursday last week.

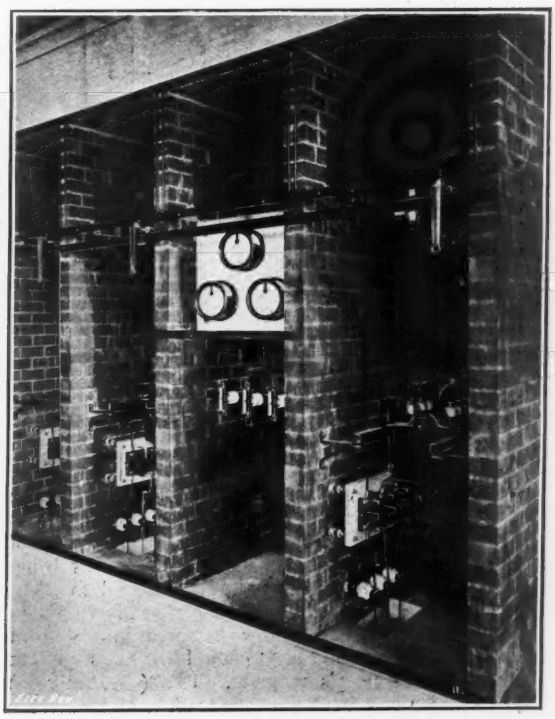


General View of Switch Gallery.

So far as we can gather, it has been the British practice to employ continuous-current motors in most cases for electrical pumping, whereas for similar purposes in Germany polyphase motors have been largely used, and when coupled with centrifugal pumps the conditions are favourable to their employment. It is hardly necessary to say that the erection of the Lindal plant has been followed with great interest by all classes of engineers, and mine and colliery owners, and here a brief allusion to the history of these mines may not be out of place. The Lindal Moor Mines property of the company comprises about 3,000 acres (freehold, copyhold and leasehold), and is traversed by the Furness Railway, with Lindal Station in the centre, thus possessing exceptional facilities for goods and passenger



Lightning Arresters.



Switch Cells Behind the Main Switchboard.

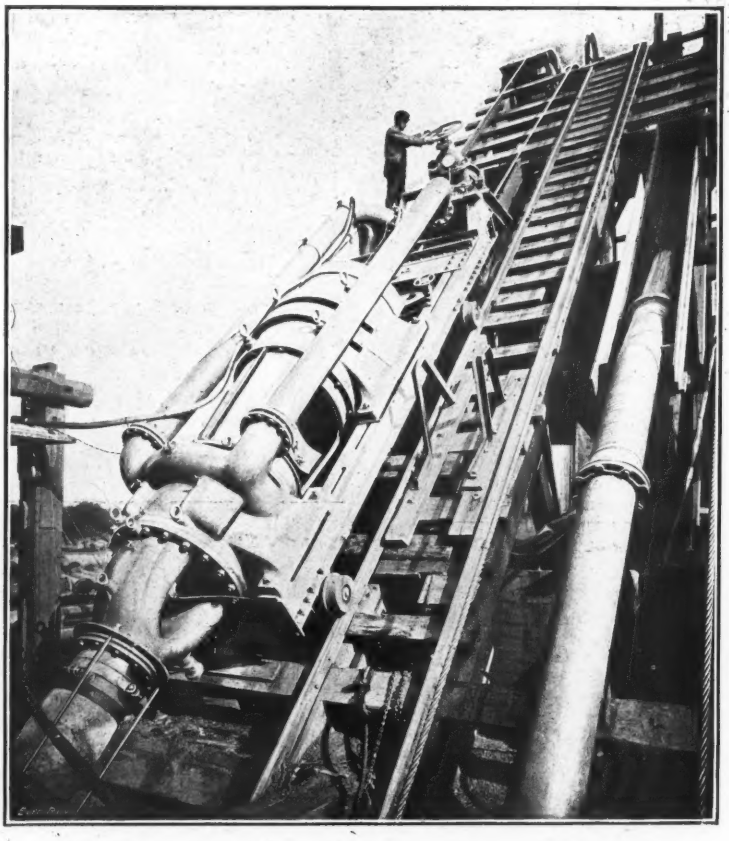
traffic. Adjoining the station are the sidings of the company, and the junctions with the different lines used for the purpose of bringing the ore from the mines to the railway, and for the carriage of coals, &c., to the grinding mill, power house, pumping and haulage plant, and generally over the property.

The conditions which existed before the installation of the new pumping plant are as follows :—

The old pumping appliances at Lowfield, Diamond, and two Bercune Mines, although of excellent design and construction, and when installed quite up-to-date, proved insufficient to cope with the water as the mines were developed, and were also very costly to work. It became apparent that greater power was essential, and the matter came up for serious consideration. The four mines mentioned were known to contain large ore bodies of great value and capable of a large output, and accordingly Mr. Henry Ward, of 110, Cannon Street, E.C., the consulting engineer to the company, was requested to advise as to the best method to be adopted to render these mines again a source of revenue to the shareholders.

After very mature and careful consideration, it was decided, in April, 1906, to erect an installation of high-speed centrifugal pumps with direct-coupled electric motors.

All the mines at which the new pumps are fitted have been proved to contain large bodies of ore, much of which was in sight when work was stopped by the overpowering inrush of water. It is confidently expected that an immediate result of the installation will be a gradual but great increase of the output of the mines. At the present time, with some 750 workpeople employed, the output is 200 to 250 tons per working day, and this, it is calculated, will increase in the near future to 1,000-1,200 tons, with an increase in the number of employés to about 1,500.



New Pump and Motor, Lowfield, on Inclined Staging.

A great feature of the installation is the mobility of the pumps and motors. With the energy generated at one central station and transmitted by cables, it is obvious that very little work will be involved in removing one or more of the pumps to other areas when once the mines now being dealt with are unwatered. It is already intended to adopt this course at an early date, when one or more of the pumps will be transferred to the large new shaft now in process of sinking on the Buccleuch area, to control the water in that portion of the company's property. This (the Grievson) shaft, in addition to being a pumping station, and relieving the company of the present expensive system whereby eight pumps are employed, will give a great working depth to the Lindal Cote mines, where the management are very hopeful of getting a large output.

As the work of exploration and proving the existence of further bodies of ore is continuously carried on simultaneously with the working of the existing mines, it will be seen that there is every prospect of the new installation being fully used. This work of exploration and proving the ground is of great importance, and a number of the present staff are regularly employed on it. It is carried on by means of hand bores, machine drills, and trial shafts. By these means workable ore has already been discovered to exist in nearly every portion of the company's property.

An important ore body was by these means found on a portion of the land held from Lord Muncaster, where, as was reported at the last shareholders' general meeting, a vein has been proved for a distance of 1,400 ft., with a depth of 140 ft. of ore-bearing ground, 25 ft. of which were solid ore, and it is a source of satisfaction to the directors to be able to state that on sinking the shaft, considerably more ore-bearing ground may be expected to become available than was indicated by the bore-hole tests. This shaft has now been sunk to a depth of 195 ft., and a heading is being driven, which at the time of writing has reached a distance of 30 ft. from the shaft, and is in a mixture of ore, clay and limestone. From the above facts it will be seen that a reliable electrical installation, generating great power and readily applicable at any portion of the property, such as that which the directors believe the contractors have supplied, must inevitably greatly facilitate the development of the mines and tend to increase enormously the output and consequent revenue.

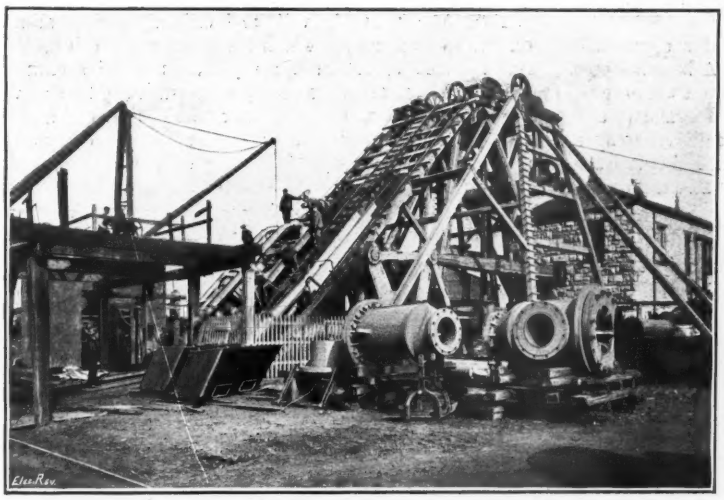
On the basis of the facts here briefly stated, it is hoped and believed that, with the works of exploration and development kept well abreast of mining and ore-getting over such an extensive area, the existence of a practically inexhaustible quantity of valuable ore, a complete and absolutely up-to-date engineering equipment showing a great margin of reserve power sufficient to meet any probable requirements for years to come, and energetic, capable and skilful management, Messrs. Harrison, Ainslie & Co., Ltd., may in the future be ranked among the great industrial concerns of the country as important ironmasters and producers of very large quantities of high-class iron ore.

The installation which has just been completed can, as the following description will indicate, clearly lay claim to particular attention on the part of engineers and the mining world generally, not only on account of the special features involved, but because it can be safely stated that this is the largest and most comprehensive plant of its kind yet put down in Great Britain.

In several of the pits pumping operations ceased in December, 1903, owing to breakdowns, and through the pumping plant then existing being insufficient to cope with the inrush of water. The pits so affected (as already mentioned, four in number) are connected together underground either artificially or by natural drainage. At the time when the pumping operations ceased, the maximum inrush of water reached nearly 7,000 gallons per minute, though the

normal dry-weather flow only amounted to about 4,000 gallons per minute.

About 3,300 gallons per minute were pumped out by the old pumping plant from two of the pits in question, one being the Lowfield Pit, 675 ft. deep, and the other the Diamond Pit, 612 ft. deep, an artificial connection existing between the two pits.



General View of the Staging and Sinking Pump, Lowfield.

Further, 3,300 gallons were pumped out from the two Bercune pits, one of which is 300 ft. deep, and the other 495 ft. deep.

For the above-mentioned reasons, and, again, owing to the then existing business conditions, the pumping operations were abandoned in the above-named pits, until the matter came up again for serious reconsideration in the beginning of 1906.

In the four pits in question three shafts were available for pumping plants, but the great initial difficulty to be overcome was the designing of plant which could be efficiently handled in the very small cage ways, and it was only after five or six schemes had been proposed and rejected that a satisfactory solution was arrived at.

Further, it was a very difficult matter to design plant of the required dimensions which would be capable of making any impression upon the inrush of water, and it was only the possibility of using electricity and high-speed pumps which induced Messrs. Harrison, Ainslie & Co. seriously to reconsider the project for pumping the mines dry.

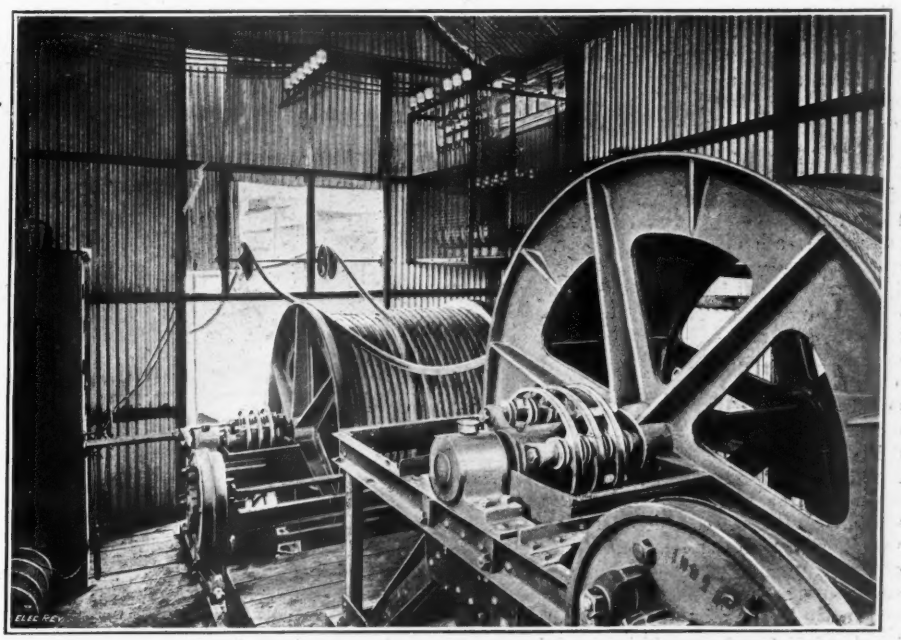
The following are the dimensions of the pump shafts, which clearly indicate the very small space which the pumping plants had to be designed to fit :—Lowfield, two shafts, each 8 ft. 4 in. × 6 ft. approx. down to a depth of 378 ft. from the top—below this depth, one shaft 9 ft. 6 in. × 6 ft. approx.; Diamond Pit, two shafts, each 6 ft. × 6 ft. approx.; Bercune Pit, two shafts, each 5 ft. 3 in. × 3 ft. 5 in. approx.

On the above-mentioned grounds a special arrangement of high-speed centrifugal pumps and direct-coupled motors was devised, and after mature consideration, the following scheme was decided upon in April, 1906, and a contract for the complete plant was finally placed with the Electrical Co., Ltd.

In each of the Lowfield Pits, which are inclined at an angle of 43°, two centrifugal pumping sets have been provided, each capable of delivering 4,000 gals. of water per minute against a total head, including friction, of 395 ft. On reaching a depth of 378 ft. where the two shafts join, these two pumps will be connected in series, and the design is such that when working in series they can together deliver the full quantity of 4,000 gals. per minute against a total head of 780 ft. One of these pumps is so designed that it can be eventually altered for duty as a permanent fixed pump to deliver 3,000 gals. of water per minute against a manometric head of 525 ft. The other pump is designed so that it can also work as a fixed pump, when it will deal with 2,100 gals. against a manometric head of 700 ft.

These two pumps are of the one-stage type, each having high grade cast-iron case, impellers and guide wheels of special bronze, and shafts of special steel. They have planed feet for resting upon a special carriage, which is constructed of structural iron and runs on rails having a gauge of 6 ft. 6 in.

The pumps each have two wrought-iron delivery pipes, which are connected at the top by means of a Y-pipe, which supports a rising main 14 in. in diameter. The check valve has an internal diameter of 375 mm., and the foot valve, 450 mm. internal diameter, fitted with strainer. Each pump has a rope sheave 4 ft. dia. mounted on suitable brackets.



Electric Cable Winches, Lowfield Sub-Station.

Each of the motors direct coupled to these two pumps is capable of a continuous output of 750 B.H.P. when working on a circuit of 3,000 volts, 50 cycles per second, and the speed of the combined sets is 1,485 R.P.M.

In the two Diamond shafts two vertical sinking pumps are provided, each of which is capable of raising 1,000 gals. of water per minute against a total head, including suction, delivery and pipe resistance, of 680 ft.

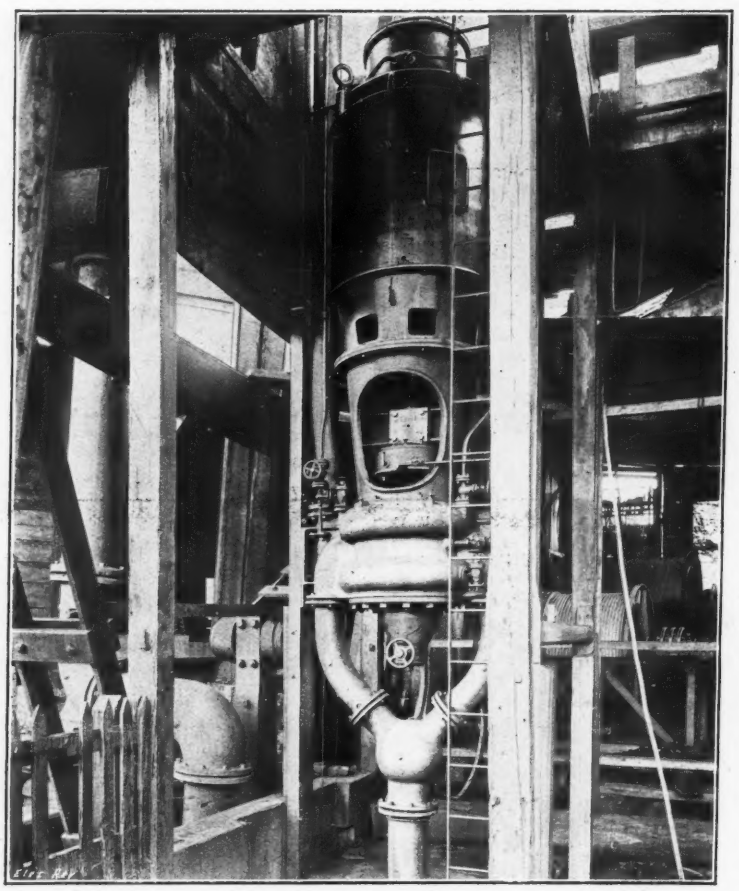
These pumps are also fitted with direct-coupled motors, having an output of 315 H.P. at 1,480 R.P.M.

The pumps are of the three-stage type, and in this case they are fitted with self-acting oil lubrication, elastic couplings, and cast-iron intermediate piece for connecting and centring the pumps with the motors. A breeches pipe is provided in each case, with wrought-iron suction pipe of 250 mm. internal diameter, foot valve, and strainer; also two wrought-iron delivery pipes, connected at the top by a Y-pipe which supports the rising main. Each set is complete with check valve, by-pass and gate valve, 225 mm. in diameter.

Each pumping set is entirely enclosed in a framing of structural iron, and a suitable rope sheave is provided for carrying the weight of the entire pump with its motor, together with the electric cable and wrought-iron delivery pipe of 200 mm. diameter, when filled with water under normal working conditions.

On the side of each set is a service ladder, with wooden platforms at the top and bottom.

In the two Bercune pits are provided two pumping plants, similarly designed to those in the Diamond shaft, but in this case each pump is intended for delivering 1,000 gallons of water per minute against a total head of 540 ft, the motors having an output of 250 H.P., and the speed of each set being 1,480 R.P.M. These pumps are each of the five-stage type. The arrangement of valves and pipes is the same as for the Diamond pumps. The suction pipe is 250 mm. in diameter, and the delivery pipe 200 mm.



Suspended Electrically-driven Sinking Pump; Cable Drums Behind.

Each of the pumping sets has a complete set of accessories, including pressure gauge, air and drain cocks, filling funnel, an ejector for exhausting the air from the pumps, gate valves with the required pipe connections, and all the necessary spanners.

The steel cables, by which means the pumps are lowered into the pits, are fastened at the pit heads, from which point they go down their respective shafts, round the rope sheave of each pump, and up again to the top of the shafts, where they are wound on the barrels of the winches provided for the purpose of raising and lowering.

The delivery pipes for the vertical pumps are each stayed in position by means of the steel wire ropes which pass up and down either side, stay rods being provided at various points with suitable guides through which the cables pass.

The weight of each of the Lowfield pumps complete with its motor, suction and delivery pipes, suspension cable, electric cable, and its own column of water is about 75 tons.

With a view to affording rapid sinking operations, the Diamond and Bercune pumps have been specially designed so that during the first half of the operations of draining only some of their impellers will be in use. By this means the pumps will initially raise nearly 200 per cent. of their normal output, and when the half-way stages are reached the full number of impellers will be brought into action.

From the above it will be seen that the total initial quantity of water with which the whole plant will be able to deal is about 15,000 gals. per minute, this being reduced to 8,000 gals. per minute as the pumps reach the lower levels.

The centrifugal pumps have all been provided and built by Messrs. Sulzer Bros., of Winterthur, who have had a unique experience in the building of high-lift centrifugal pumps* for heavy duty.

The motors are specially designed for working under the abnormal conditions, and are constructed with particularly small dimensions to admit of their passing down the narrow cage ways available.

The motors are all fitted with short-circuited rotors; the motor cases are arranged with ample ventilation, and a forced circulation of air is maintained by means of fans fitted on the motor shafts.

Although the motors are of the ventilated enclosed type, there is ample protection by means of suitable hoods against falling water or fragments of rock, &c.

A special feature is that the high-pressure current of 3,000 volts is taken directly to the motors *without intervening transformers*, all terminals and live parts being securely protected in such a manner that there is absolutely no risk of danger to the men in charge.

The combined efficiencies of the pumping sets are:—Lowfield, 73 per cent.; Diamond, 67·75 per cent.; Bercune, 72 per cent.

In order to provide power, a central generating station has been built on a suitable site at a short distance from Lindal Station on the Furness Railway, where there is a sufficient supply of water for condensing purposes.

The distance from the station to the three pits is:—To Lowfield, 980 yards; to Bercune, 800 yards; to Diamond, 1,720 yards.

A three-phase alternating-current system has been adopted, and in order to transmit the required power without undue loss, and at the same time have a working pressure which could be used direct in the motors without transformers, a pressure of 3,300 volts with a periodicity of 50 cycles per second was chosen.

The current is generated by three steam turbo-generators

* The Sulzer sinking pumps employed at Wilhelmina Pit, near Haarlem, were described in the Electrical Review for January 25th, 1907.

of the horizontal type, designed and constructed on the A.E.G. principle,* each set being capable of a continuous output of 1,140 electrical horse-power, at 3,300 volts pressure and 50 cycles per second, when running at 3,000 R.P.M., and supplied with steam having a pressure of 200 lb. per sq. inch at the stop-valve, and superheated to a temperature of about 600° F. Each turbine exhausts into a surface condenser of Messrs. Worthington's manufacture, specially designed for maintaining the high vacuum which is necessary for the efficient working of turbine plant.

By a special system of ventilation and by water circulation in a double casing round the generator carcase and bearings, the entire generator is kept particularly cool.

Each turbo-generator has its own exciter direct-coupled to the main shaft, and, by means of the "Tirrill" system of regulation, which automatically adjusts the excitation, the terminal voltage on the generator is kept absolutely constant, irrespective of load fluctuations.

The steam range, which has been erected by Messrs. Babcock & Wilcox., is of a simple design, and so arranged that each boiler and each turbine can be isolated.

A steam separator is built into the steam range adjacent to each turbine. These separators are of the A.E.G. type, and are built to meet the special requirements of turbine installations, the design being such that they absolutely prevent any grit or fine boiler scale passing over from the steam range into the turbine nozzles.

The boiler plant consists of three Babcock & Wilcox water-tube boilers, each having 4,020 sq. ft. of heating surface, and arranged in one and a half batteries. Each boiler is capable of evaporating, under the most efficient conditions, 15,000 lb. of water per hour. The boilers are fitted with Babcock & Wilcox patent internal superheaters, each having 880 sq. ft. heating surface, and capable of imparting 200° F. of superheat to the steam produced.

Each boiler is provided with a mechanical chain-grate stoker of the Babcock & Wilcox pattern, having a grate area of 74·7 sq. ft., the three stokers being driven from one shaft by a small three-phase motor.

The feed water is delivered by a Weir pump, series III single-acting type (of which there is a duplicate set as a stand-by), through an electrically-driven Green fuel economiser of 400 pipes.

The steam consumption obtained on test was about 15½ lb. per KW.-hour with a vacuum of 95 per cent., and steam at a pressure of 200 lb. and a temperature of 572° F. This figure compares very favourably with the guaranteed figure given by the contractors of 18·2 lb. per KW.-hour.

The output from the turbo-generators and to the motors is controlled by a main switchboard of special cellular design, which is one of the first boards of this type erected in this country. There is no marble whatever in the construction of the board, the front being constructed of tiled masonry upon which the instruments are mounted, the switches, &c., being operated by means of handwheels. The connections are made to the switchgear by means of spindles passing through the tiled wall, these driving either direct on to the switchgear, or by sprocket wheels and chains. This arrangement ensures the entire isolation of the high-tension apparatus, and effectually minimises fire risks and danger to the staff.

A special feature of the plant is that each of the six pit motors is individually under the control of the power house engineer, the whole of the starting and stopping operations being carried out by means of the switchboard apparatus.

A word is necessary respecting the arrangement of the controlling device.

Two sets of bus-bars are provided behind the switchboard, one set for running the motors under full pressure, and the other for gradually raising the pressure at starting. The latter is effected by means of two transformers connected in series, one of these is an auto-transformer which reduces the voltage to about half the working pressure, the second transformer has its primary connected in series with the auto-transformer and its secondary connected to the liquid resistance which is gradually short-circuited on starting the motors.

By this means the pressure on the motors is increased gradually, and large current rushes which might in the ordinary way affect the voltage regulation of the station are avoided.

As soon as the motors have been run up to full speed on the auxiliary bus-bars, they are switched on to the main bars by means of change-over switches of the oil-break pattern.

To protect the motors against overload, each line is provided with automatic maximum-current circuit-breakers. The hand-wheels operating the oil switches are connected thereto by means of trip gear operated by solenoids, which are fed with current direct from the bus-bars. The circuit-breakers are controlled by the relays, which are fed through special current transformers from the mains, and as soon as the current exceeds a maximum value, the relay closes the solenoid circuit on the oil switch. This solenoid releases the switch from the hand-wheel, and the switch is thrown open by means of powerful springs. The controlling relays can be set to act with various overloads as desired, and can be fitted either for instantaneous operation, or with a time element which will only allow them to act after an overload has been on for some predetermined time.

The arrangement of the switch and control gear, it will be seen, dispenses with the considerable staff which would otherwise be required. In this case the whole of the operations of the plant are directly under the control of the engineer in charge of the station, the only apparatus at the pit heads consisting of an isolating switch in each case, with a voltmeter to indicate when the current is on or off.

On each motor in a convenient position is fixed an ammeter enclosed in a special watertight case.

To permit of the motors being controlled from the engine house, a separate transmission line constructed of bare copper is run from the generating station to each motor, these cables being suitably carried on triple-shed high-tension porcelain insulators, tested to 10,000 volts, which are fitted on channel iron cross arms erected on wooden poles. Where only six wires require to be carried, one wooden pole is provided, but in every other case the line is carried upon double poles about 8 ft. apart.

The cross-section of the transmission lines is—to the Lowfield Pit, 50 sq. mm. per phase; to the Bercune and Diamond Pits, 25 sq. mm. per phase.

At the point where each transmission line terminates at the Pit Head sub-station, the bare copper cables are connected to high-tension vulcanised rubber cables through a junction box mounted on the transmission line pole. The high-tension cables are in their turn connected through the isolating switch and collecting brushes to the slip-rings of a specially devised cable drum.

The cables which carry the high-tension current down the pits directly to the motors are of flexible pattern, designed for transmitting the full power continuously. They are of three-core stranded type, insulated with pure and vulcanised rubber, the rubber being specially selected so as to render the cables entirely safe for a constant working pressure of 3,000 volts between phases.

The three-core cable for each motor is wound on its respective cable drum, one end being connected to the slip-rings on the shaft; the other end is connected, through a water-tight junction-box fitted on the side of the motor, direct to the motor terminals.

By means of this arrangement the cable is paid out as the motor is lowered down the pit, and the whole of the live cables and terminals are effectually sealed and protected mechanically and electrically.

The isolating switches referred to above, which are fitted at the pit-heads, are further arranged with mechanical devices by means of which the men in the pits in charge of the pumps can, in case of emergency, immediately disconnect the motors from the mains.

A complete telephonic system has been installed between the power house and the various pits, by means of which the necessary communications can rapidly pass between the engineer in the power house and his staff at their various stations.

The whole of the contract, which, from the boilers to the pumps, does infinite credit to the Electrical Co., Ltd.,

* The Riedler-Stumpf turbine, of which the present type is a development, was described in the ELECTRICAL REVIEW, March 4th, 1904.

has been carried out under the supervision of Mr. Henry Ward, M.Inst.C.E., 110, Cannon Street, London, E.C., consulting engineer to Messrs. Harrison, Ainslie & Co., Ltd.

We must not omit to mention that the wire ropes, made of Cradock's galvanised special plough steel, and used in connection with this plant for suspending the pumps, were supplied by Messrs. George Cradock & Co., of Wakefield.

Our thanks are specially due to Dr. Herzfeld, of the Electrical Company; Mr. Henry Ward, the consulting engineer; and to Mr. Burrell, the engineer-in-charge of the electrical plant in the power house, for supplying us with data for the compilation of this article; and Messrs. Harrison, Ainslie & Co. left nothing undone which thoughtfulness and foresight could suggest for the comfort and thorough enjoyment of their visitors and guests. *Finis coronat opus!*

CONTRACTS OPEN and CLOSED.

OPEN.

Argentine Republic.—June, 1908. The municipal authorities of Buenos Ayres are reported to be about to invite tenders for the concession for the construction and working of an underground electric tramway in the city. Tenders will be received until June 1st, 1908, and particulars may be had from the Legation in Paris.

Australia.—Melbourne.—November 12th. 6,000 dry cells for the Deputy Postmaster-General of Victoria. Commonwealth Offices, 72, Victoria Street, S.W., or Board of Trade Commercial Intelligence Department. Specification can be seen at the offices of the Electrical Review.

Melbourne.—December 10th. Fifty telephones (wall sets). Tenders to the Deputy Postmaster-General, Melbourne, by 3 p.m. on December 10th. Specification may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C., or at the office of the Electrical Review. Tenders, forms, &c., may be obtained at the Australian Commonwealth offices in London, 72, Victoria Street, S.W., where also preliminary deposits on tenders may be paid.

Melbourne.—October 30th. 95,000 incandescent lamps for the City Council. See "Official Notices" to-day.

New South Wales.—November 6th. Postmaster-General's department. 14½ tons hard-drawn copper wire (300 lb. per mile); 4 cwt. copper binding tape (200 lb. per mile, $\frac{3}{16}$ in. wide); 3,500 large insulators (best white porcelain); 1,000 tallow-wood cross-arms, 3 ft. 10 in., complete; 2,500 ditto, 5 ft. 2 in. Specifications and general conditions may be seen at the offices of the Electrical Review.

New South Wales.—December 11th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, for the supply and delivery, at the Central Exchange, General Post Office, Sydney, of the following: 1,000 telephones, wall, common battery; 100 telephones, table, common battery. Specifications may be seen at the offices of the Electrical Review.

New South Wales.—Sydney.—November 6th. The Water and Sewerage Board require tenders for centrifugal pumps and electric motors for the low-level sewerage system of Sydney.

South Australia.—January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

Victoria.—January 7th, 1908. The Postmaster-General requires tenders for 11 sections of a common-battery switchboard and 3,000 subscribers' telephones and other apparatus, for the telephone exchange at Windsor.

Albany (W.A.).—November 18th. Tenders are required by the municipal authorities of Albany for the public and private lighting of the town by gas or electricity for the next 15 years. Tenders to Town Clerk, Ernest B. Paton.

Adelaide.—November 26th. The Agent-General for South Australia, 28, Bishopsgate Street Within, E.C., has received specifications for tramway rails and fishplates required by the Adelaide Tramways Trust, which has the electrification of these lines in hand. A deposit of £3 3s. is required.

Belgium.—Brussels.—October 25th. A public adjudication will take place at the Hotel de Ville at 1.15 p.m. for the supply of the electric cables required by the municipal electric supply department. A deposit of £40 is required. Particulars may be obtained from the Municipal Electrical Engineer-in-Chief, at 5d. plus postage. Tenders must be delivered before 11 a.m. on the date named.

Brussels.—October 23rd. The Belgian State Railways Department requires tenders for cables and electrical accessories. Specification may be obtained on payment of 5d. from M. de Rudder, 11, Rue de Louvain.

Dundee.—October 21st. The T.C. invites tenders for (1) reinforced concrete foundations of generating station, pump room, &c. Jas. Thomson, City Architect.

Edinburgh.—November 8th. Junctions and pits for tramways extensions for the Corporation. Specification, &c., from Sir A. B. W. Kennedy, 17, Victoria Street, S.W., consulting engineer (two guineas).

Egypt.—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

Grimsby.—October 21st. Switchboard panels for the Corporation electricity department. See "Official Notices" September 27th.

G.W. Railway.—October 22nd and November 12th. Stores, including a number of electric and telegraph sections, for one year. See "Official Notices" October 4th.

Italy.—November 4th. The municipal authorities of Acireale, in the province of Catania, require offers for the installation and working of an electric lighting and power plant, for 30 years. The city will contribute £1,480 per year for 112,278 kw.-hours, and the company must deliver any further energy required for lighting at 3½d. per kw.-hour. A deposit of £160 is required. Tenders are to be made to the Sindreo, and the amounts and names are to be considered strictly confidential.

Llandilo.—November 2nd. 200 yds. electric light cable and four lamps for the U.D.C. Specification from R. Shipley Lewis, Clerk to Council, Llandilo.

New Zealand.—December 11th. The Napier T.C. requires tenders for electric tramways, lighting and power supply. Frank N. Bower, Town Clerk.

Paris.—October 24th. The Municipal Waterworks Department (Service des eaux, canaux et égouts) requires tenders for the supply and erection at the Austerlitz works of (1) four sets of motor-driven pumps, dynamos, &c., complete, capable of lifting 100,000 cubic metres of water per day into either of two reservoirs, or 50,000 cubic metres into both at the same time; (2) and one reserve set; (3) 10 boilers, in two groups of three, and one of four. Particulars may be obtained at the Hotel de Ville.

Portrush.—November 2nd. Lighting installation (electricity or gas) for the U.D.C. Specifications prepared by Mr. J. Woodside, may be seen at the offices of the Council, Town Hall.

Rochdale.—October 19th. Steam dynamo for the Corporation electricity works. See "Official Notices" October 11th.

Russia.—The municipal authorities of Wilna are about to invite tenders for the supply of a tubular boiler, steam turbine and dynamo for the central electric lighting station.

Spain.—Pontevedra.—October 22nd. The municipal authorities require tenders for installation and working of electric lighting in the town &c., for 20 years. Particulars may be obtained from the Ayuntamiento Constitutional.

Toro.—October 30th. The municipal authorities require tenders for the installation, maintenance, &c., of public and private electric lighting for 10 years. Particulars may be obtained from the Ayuntamiento Constitutional, to which authority tenders are to be addressed.

Tobarra.—Tenders have just been invited by the municipal authorities of Tobarra (province of Albacete) for the concession for the electric lighting of the town during a period of four years, and by the municipal authorities of Alboraya (Valencia province) for a term of three years.

Madrid.—November 5th. The Public Works Department requires tenders for the construction and equipment of a lighthouse at Machichaco (Biscay), estimated to cost over ¼ million pesetas. 1 per cent. deposit is required. A local agent is advisable.

Shoreditch.—The borough electrical engineer having pointed out the serious consequences which would result if the largest feed pump at Whiston Street station should break down temporarily, and the necessity of providing an additional pump which would be available in such a contingency, the Lighting Committee is obtaining quotations for a boiler feed pump dealing with at least 5,000 gallons per hour. The estimated cost is £100.

Stepney.—November 11th. Steam and electric generating plant, &c., for the Blyth's Wharf generating station, and the sub-station equipment, for the Council. See "Official Notices" October 11th.

Stockport.—The Corporation Tramways Committee requires tenders for the relaying of the permanent way, &c., in connection with the Stockport Road and Gordon Road improvement, the Chestergate interlacing lines, and the car-shed approaches. Particulars may be obtained from the borough surveyor.

Tunbridge Wells.—November 1st. 500-KW. turbine, alternator and exciter, surface condensing plant and pipe-work for Corporation electricity works. See "Official Notices" Sept. 27th.

Warrington.—October 22nd. Paper-insulated cables for the Electricity Department. See "Official Notices" Oct. 4th.

Willesden.—October 28th. Carbons for the U.D.C. for one year. See "Official Notices" to-day.

Wrexham.—October 22nd. One 50-KW. steam set for Electricity Department See "Official Notices" October 4th.

CLOSED.

Croydon.—On Monday the B.C. accepted the tender of Messrs. S. H. Heywood & Son for an overhead runway at the electricity works, to provide greater facilities for handling coal, at £234. In addition to the runway a further expenditure of about £24 was authorised for a weighing machine and skips. The whole of this expenditure will be charged to the revenue account. The quantity of coal dealt with at the present time is about 12,000 tons per annum.

Devonport Dockyard.—We understand that Messrs. Cowans, Sheldon & Co., Ltd., of Carlisle, have been commissioned to supply the crane equipment required by the Admiralty at the new dock at the Devonport Dockyard. The installation will consist of one 20-ton and two 30-ton steam travelling cranes; two 75-ton electric Fairbairn cranes; and a 160-ton electric revolving cantilever crane. This last-mentioned crane is of an interesting type, and when in working order, it is claimed that it will take rank as the largest crane erected in any private or Government ship-yard in the world. The concrete foundations for the crane are now being prepared on behalf of the Admiralty by Sir John Jackson, Ltd. The crane is designed to lift 160 tons at a maximum radius of 95 ft. and 80 tons at 105 ft., the extreme radius for light loads of 30 tons being 128 ft. The height from the quay level to the top of the girders will be 143 ft. 6 in., and the overall length of revolving girders, which are 28 ft. deep, will be no less than 220 ft. The machinery for the light and heavy lifting and for traversing the crab will be situated in a house at the back end of the girders. The revolving girders are carried on a braced tower 46 ft. square, and about 110 ft. high. The crane will have main lifting, light lifting, traversing and revolving motions, each worked by a separate electric motor of the Westinghouse enclosed type. The crane will be tested with the unusually heavy load of 240 tons, and although only nominally designed for lifts of 160 tons, it will be to all intents and purposes a 200-ton crane.

Dundee.—After many weeks' delay, the T.C. has accepted an offer by the British Insulated & Helsby Cables, Ltd., to supply the required cables, for £10,000.

A long discussion took place at the special meeting called to deal with the the matter, which was regarded as one of great urgency. Mr. William Don, convener of the Electrical Committee, explained that the Committee already had twice had before them offers for the supply of cables, and on each occasion, because of the offers being much higher than they felt justified in accepting, they sent back the offers and asked for fresh tenders. The original offer made was somewhat over £12,000, but that included an item which they had since seen their way to do without, and there was roughly a saving of £1,200 upon the contract now proposed for acceptance. By asking for renewed offers time and again, they had managed to prevail on this firm to give them a much lower offer, and an offer such as they felt justified in recommending the Council to accept. The figure of £10,000 was a little under the original estimate of the work put before the Council. Continuing, he said the difficulty the Committee had was to get competition between the various British firms. They had sufficient evidence to justify them in believing that there was no *bonâ fide* competition between these firms. Now they had got one of the firms to meet the wishes of the Committee, and the firm in question had given them a special offer, made conditional on its being accepted within a limited time. This was because of the uncertainty of the copper market, which had been going up of late. It had gone up £1 or £2 in the last few days, and the tenderers had telegraphed that if the offer was to be accepted, it must be done at once. Mr. Don therefore moved the acceptance of the offer of the British Insulated & Helsby Cables, Ltd. This having been seconded, a member asked whether due consideration had been given to the possibility of the copper market dropping. The convener replied in the affirmative, and added that copper had been up at £100 per ton within the last 12 months, and it had dropped to about £55, the drop being one of 40 to 50 per cent. There was just a possibility of it rising again, and he thought the time had come for the fixing of the contract.

A member having remarked that from what could be learned copper was not likely to fall further, Mr. Don said if there was a likelihood of their being able to save another £1,000 he would defer. The fact remained, however, that they had now got a much lower offer than they had hitherto received from foreign and Continental firms. The Lord Dean of Guild, Mr. Dickie, said copper was now about its normal price, and if it rushed back they would probably have to pay a great deal more. Therefore he strongly supported the acceptance of the offer. Another member did not think the reduction in the offer from £12,000 to £10,000 was commensurate with the reduction in the price of copper, and the Lord Dean of Guild pointed out that when the first offer was given copper was selling at from £70 to £80, while the price now was £63. Replying to several members, the convener stated that the engineer formed his estimate of the work when copper was in the vicinity of £70. It was necessary to get the work taken in hand in a month or so.

The offer was then unanimously accepted.

Liverpool.—The Liverpool County Hospital for Children have placed an order with the Keighley Electrical Engineering Co. for three electric lifts to be supplied.

London.—HAMMERSMITH.—The Electricity Committee has accepted the following tenders, subject to the completion of an agreement with the Franco-British Exhibition Committee respecting the supply of electricity:—

Western Electric Co., Ltd.—8,000 yds. ·25 feeder cable, and 90 joint boxes, £3,468.

Lahmeyer Electric Co., Ltd.—1,000 yds. ·125 three-core cable, and 12 joint boxes, £400.

L.C.C.—The Highways Committee of the L.C.C. has received the following tenders for the supply of boiler feed pumps, &c., for the second portion of the generating station at Greenwich:—

John Cochrane, Barrhead, N.B.	(recommended)	£2,100 0
Pratchitt Bros., Carlisle		2,244 10
Thames Ironworks Co.		2,298 5
A. & P. Stenny, Glasgow		2,389 15
E. Scott & Mountain		2,508 5
Glenfield & Kennedy		2,564 0
Thwaites Bros.		2,597 16
Electric Construction Co.		2,695 0
Johnson & Phillips		3,336 2
Haste Pump Co.		3,662 7

The successful firm proposes to sub-let to Messrs. Mavor and Coulson the work of constructing the motors and controllers. The undernoted tenders have been received for the renewal of the wiring and the electrical plant and steam engine on the Woolwich ferry boat *Hutton*:—

Electrical Co.	£378	Siemens Bros. & Co. (alter.)	£499
Pinchin & Walton	401	Foote & Milne	517
Siemens Bros. & Co.	455	Electric Construction Co.	625
" " (alternative)	497	Smeeton & Page	695

The tender recommended for acceptance is that of the Electrical Co., who propose to sub-let the renewal of the steam engine to Robey & Co., and the renewal of the dynamo to the Brush Co. or the British Thomson-Houston Co.

Sheffield.—The T.C. has accepted the tender of the United States Products Co. for the supply of copper bonds for a year, at £1,101.

Stockport.—The Tramways Committee has accepted the tender of the British Insulated & Helsby Cables, Ltd., for cables, at £565 10s., and for overhead equipment; and has given to Hadfield's Steel Foundry Co. the order for the alterations to the tramway track at Gorton Road, at £121 10s.

Storthes Hall Asylum.—The West Riding County Council has accepted the tender of Messrs. J. H. Taylor & Co., of Huddersfield, for the electric lighting of the Acute and Epileptic Blocks at the Storthes Hall Asylum, at £3,349, and the tender of Messrs. Cox-Walker & Co., Darlington, for the supply and fixing of electric bells, telephones, fire alarms, recording clocks, &c., at the same institution, at £651.

Willesden.—The U.D.C. has accepted the tender of the British Electric Transformer Co., at £71, for the supply of transformers.

Wolverhampton.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for two Tirrill regulators, with the auxiliary machinery, at £420, and that of Messrs. Mountain & Gibson, Ltd., for the conversion of the snow plough into one of more modern and efficient type, at £145.

The Tramways Committee has decided to expend £185 in the purchase and fitting of 24 Hudson & Bowring life guards, to renew the existing guards on 24 tramcars, and has accepted the tender of the Anglo-American Oil Co., Ltd., for the supply of petrol, at 9¼d. per gallon, for the period ended June 30th, 1908.

The Electricity Committee has arranged to enter into a contract with the Holly Bank Colliery Co., Ltd., relative to the supply of fuel to the electricity works.

Yarmouth.—The T.C. has accepted the following tenders:—

Crompton & Co., Ltd., 10-H.P. motor with slide rails, switches and starters, £36.

Miller & Co., wheel press, £88.

Geo. Hatch, Ltd., forge and emery machines, £30.

Messrs. Brown & Colby, shafting, 11s. 2d. per cwt., and pulleys

FORTHCOMING EVENTS.

Engineering and Machinery Exhibition at Olympia. Open until October 19th.

To-day's Events (Friday, October 18th).—At 8 p.m. At Institution House, Storey's Gate, St. James's Park. Monthly general meeting of the Institution of Mechanical Engineers. Paper on "The Indicated Power and Mechanical Efficiency of the Gas Engine," by Prof. B. Hopkinson.

At 7 p.m. At Westminster Palace Hotel. Annual general meeting of the Junior Institution of Engineers, followed by meeting of the Benevolent Fund.

At 9 p.m. In the Theatre of the Royal Institution. Extra meeting of the Chemical Society. Prof. Emil Fischer, F.R.S., will deliver the Faraday Lecture, entitled "Organic Synthesis and its Relation to Biology."

Thursday, October 24th.—At the University, Leeds. Institution of Electrical Engineers (Leeds Local Section). Presidential address by Mr. G. D. Aspinall Parr.

Friday, October 25th.—At 5 p.m. At Royal College of Science, Imperial Institute Road, S.W. Meeting of the Physical Society.

At 7 p.m. Junior Institution of Engineers. Visit to "Model Engineer" Exhibition, Horticultural Hall, Vincent Square, S.W.

Saturday, October 26th.—At 2.30 p.m. Junior Institution of Engineers. Visit to Blackfriars Bridge widening works.

NOTES.

Maintenance Costs on the "District."—The *Railway Gazette* of Friday last, in an editorial comment on this subject, says:—"It is common knowledge that since the conversion of the system to electrical working, very large sums have been spent by the District Railway on track renewals, both as regards rails and road bed. The excessive wear on the rails has frequently been referred to by Sir George Gibb, and experiments are now being undertaken to obtain a rail better suited to the conditions of working prevalent on the system. On more than one section of the line, it has been found necessary to renew the rails on curves no less than three times since 1905. The road-bed was also in many ways unsuitable for the greatly increased speeds of electrical operation, and a large amount of fresh renewal work has been done since the final withdrawal of the steam trains, although it had been arranged that re-ballasting should be carried out over the entire system previous to the inauguration of electrical working. The cost of maintaining the rolling stock has also been a serious item, and the repair bills for the cars are swallowing up at least the sum originally saved on their construction. The form of brake-rigging designed by the company's master mechanic has been another costly experiment. In fact, until these fittings had been modified according to the makers' original intention, the action of the brakes was about as unsatisfactory as possible, passengers being violently thrown down every time a train stopped. This defect also contributed to the wear on, and damage to, the rails. Compared with the Metropolitan, the District appears to have saved on the first cost of its track and equipment, but the Metropolitan is now benefiting by lower maintenance costs, in addition to possessing more satisfactory and efficient rolling stock. The District's very heavy expenditure on upkeep is an undoubted factor in the company's unfortunate financial position, in spite of the heavy traffics and the continuous introduction of fresh operating and administrative economies."

Fatalities.—On the 11th inst., at Swalwell-on-Tyne, a Coroner's jury returned a verdict that a youth named Joseph Chadwick, a "cleaner" at the Blaydon engine sheds of the North-Eastern Railway Co., had been killed by an electric shock received from an electric hand-lamp, one of the wires having been partly bared by the insulating material being accidentally cut through. Chadwick was on the "cab" of an engine under repairs, when he cried out; a workman went forward and took the lamp from Chadwick, receiving a shock as he did so. Chadwick then fell to the ground and died immediately.

A Belfast correspondent says that last week the dead body of Michael Condon was found in a stream below Ashgrove Mills, Menmare. The deceased was employed at the electric light works, Ashgrove, for the past five months, and it is surmised that whilst looking after the turbines which drive the dynamos, his hand was caught by the cogs and he was thrown into the stream. This is inferred from the fact that one of his hands was badly mutilated.

Economy of Blast-Furnace Gas Power.—A paper recently read by Mr. F. Sellge before the German Iron and Steel Works Society, on the difficulties met with in the working of large gas engines, and methods of overcoming them, contains an interesting statement as to the working results obtained at the Differdinger Iron and Steel Works, of which Mr. Sellge is the gas-engine manager.

Before the introduction of gas power, the amount of coal consumed for generating steam was 5,300 tons per month, the output of pig-iron in the same period being 21,400 tons, of which 70 to 80 per cent. was converted into steel and rolled, while the remainder was turned out as billets. The cost of coal, at 18s. per ton, was £4,770, or 4·46s. per ton of pig-iron. When gas engines were installed, the coal consumption diminished to about 500 tons per month, costing £450, while the output of iron has increased to 30,000 tons per month. the cost of fuel for power being therefore reduced to 0·3s. per ton of iron; assuming that under the former conditions with steam power the cost of fuel would have increased in proportion to the output of iron, the saving amounts to 4·16s. per ton, equal to £6,240 per month, or about £75,000 per annum. At the same time the cost of handling the coal and attending to the boilers has greatly diminished.

The cost of labour and repairs would probably be no greater with gas plant than with the original steam engines and boilers. It is estimated that the cost of the complete installation, including a sufficient proportion of plant for blowing, would be £481,620; the saving of £75,000, therefore, amounts to 15·6 per cent. on the new capital, amply sufficient to provide for depreciation, with a margin of something like 10 per cent. for interest.

Institution and Lecture Notes.—Engineering and Machinery Exhibition at Olympia.—On Tuesday evening last week Mr. Chas. Bright, F.R.S.E., explained the principles of submarine telegraphy to a large and appreciative audience. In the course of his lecture, Mr. Bright described the methods of transmitting electrical signals through cables, the various stages of construction in a cable from the copper conductor and insulator to the iron sheathing, and the methods of surveying the ocean, of laying the cable and providing for irregularities of the bottom. A *résumé* of submarine cable work from the very commencement was next given, with portraits of the pioneers, and views of the various stations. There are some 257,000 miles of cable in all at the bottom of the sea, representing over 52 millions sterling, each line costing about £200 per mile to make and lay. The average useful life of a cable nowadays may be anything between 30 and 40 years. About six million messages are conveyed by the world's cables throughout the year, or 15,000 a day, the working speed for any one cable being up to 100 words per minute under present conditions. About 90 per cent. of these messages are sent in word or cipher code, for business and official purposes. The social, inter-Imperial, political and strategic importance of cables was then discussed, as well as the tariffs.

Institution of Electrical Engineers (Glasgow Section).—The sixth annual dinner is to be held on November 20th; those intending to be present should apply to the hon. sec., Mr. J. E. Sayers, 157, West George Street, Glasgow. We have received the neat little booklet of the Section containing the calendar for the session 1907-8, rules, &c.

The Electric Supply Football League.—On Saturday next the opening match in this competition takes place at Victoria Road, Willesden, the kick-off being timed for 3.15 p.m. The League has been fortunate in having for its officers the following gentlemen:—

President.—Lord Kinnaird.

Vice-Presidents.—Sir Alex. B. W. Kennedy, F.R.S., S. Dobson and F. J. Walker (St. James' Electric Supply), J. S. Highfield (Metropolitan Electric Supply Co.), A. L. C. Fell (L.C.C. Tramways) and J. T. Baron (St. Pancras Electricity Department).

During the season, 24 matches will be played in all, and the club obtaining the highest number of points will be the champions.

At the annual general meeting Mr. T. C. Brice (St. James' Electric) was elected chairman, and with the following clubs comprising the League, a successful season is looked forward to with every confidence:—St. James' Electric F.C.; St. Pancras Electric F.C.; Metropolitan Electric F.C.; and the L.C.C. Tramways Power Station F.C.

Reading Tramway Men at Church Parade.—On Sunday morning last, the first church parade of the employés and staff of the Reading Corporation tramways took place, when upwards of 100 men mustered and marched in procession, headed by the Reading Temperance Prize Band, to St. Giles's Church. The Mayor of Reading, the chairman of the Tramways Committee (Mr. Alderman Field, J.P.), Mr. Walter Binns (general manager and engineer), and members of the Tramways Committee, took part in the parade. The sermon was preached by the Lord Bishop of Oxford (Dr. Paget), and the music for the hymns was rendered by the band. A collection was made on behalf of the Royal Berkshire Hospital.

Petrol v. Electric Fire Engines.—At the trials of a new petrol motor fire engine in Glasgow, the Edinburgh Firemaster stated that while petrol-driven engines were a great improvement on horses, still they had their peculiarities. He thought that eventually electric power would be used for driving the fire engines and escapes as the most useful for the purposes.

Appointments Vacant.—General manager and engineer for the Rhondda tramways undertaking (£450); assistant examiners in the Patent Office; traffic inspector for training motormen and conductors, &c. (45s.); engineer for the Indian Government Public Works Department; temporary mechanical assistant engineer for Crewe electricity works.

L.C.C. and Engineering Workshops.—A step in connection with an endeavour to afford some relief to engineering employers in London was taken at Tuesday's meeting of the L.C.C., when it was decided to promote legislation to secure an amendment of the London Building Act, 1894, in respect of the size of engineering shops, and with the object of preventing the further removal of works from the metropolis. The subject came forward on a report by the Building Act Committee, who recently received a deputation from the London and District Association of Engineering Employers, asking for the removal of the restrictions as to cubical extent imposed by the Act. The deputation stated that the restrictions made it almost impossible for engineering firms to carry out their work in London in accordance with modern requirements, that many firms had already removed their works from the county, and that others would be compelled to follow their example unless a change took place. In the opinion of the Committee, the restrictions pressed very severely, not only on the engineering trade, but also on many other trades and businesses, and they were supported in that view by the fact that applications were frequently made to the Council for permission to erect buildings of the warehouse class exceeding 450,000 cb. ft., which, under the present law, the Council was unable to grant. It was strongly represented in connection with those applications that the limit of 450 000 cb. ft. had the effect, not only of embarrassing trades and businesses, but of preventing important and essential developments rendered necessary by modern commercial methods; and it was further pointed out that such restrictions do not obtain in other towns. The Committee thought that the difficulty would best be removed by amending the London Building Act, 1894, so as to give the Council full discretion to allow buildings to be erected of such cubical extent as might be considered reasonable. In the event of the Act being amended as suggested, the Committee stated that it would be desirable for a statement to be drawn up and adopted by the Council, laying down the principles which would guide the Council when dealing with applications to erect buildings exceeding 450,000 cb. ft. in extent. Mr. F. Goldsmith, chairman of the Committee, cited the removal of Messrs. Siemens Bros. from Woolwich to Stafford as an example of one of the results of the existing restrictions, and he stated that the Institution of Electrical Engineers put the question before the Council several years ago. After a long discussion, the Council resolved to make application in the next session of Parliament with a view to the amendment of the London Building Act, 1894, in the following way:—(1) Sec. 75 to be amended so as to enable the Council to allow horizontal separation; (2) Sec. 76 to be amended so as to remove all restrictions on the Council's power to allow increased cubical capacity for buildings of the warehouse class; and (3) Sec. 77 to be amended, on the lines laid down in the London Building Acts (Amendment) Bill, 1905, so as to give the Council discretionary power with regard to openings in party walls, the provision of fire-resisting doors constructed of materials other than iron, and the uniting of buildings.

Electric (?) Fire.—The *Daily Mail*, October 15th:—"Owing to the fusing of electric wires, a fire broke out early yesterday morning in a bedroom at the residence of Mr. Harold J. Baring, of Walls Grove House, High Beech, Essex. . . . The damage is estimated at £500." The cause of the fusing appears to remain wrapped in mystery; for the generating plant has not been put to work, and there are no cables run to the house.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Wolverhampton T.C. on Monday, after a long discussion, resolved to increase the salary of MR. SHAWFIELD, borough electrical engineer, by £75 at once—making his remuneration £520—and another £75 next year. In April last a proposal was made to give him an advance of £150 at once, but that was rejected by the Council, and the present increase is in the nature of a compromise.

The Electricity Committee of the Hammersmith Borough Council received 190 applications for the position of canvasser and agent for the electricity department. They have appointed to the position MR. H. W. MARSHALL (who is at present engaged in the Consumers' Complaint Department of the Metropolitan Electric Supply Co., Ltd.) at a salary of £2 10s. per week, rising to £3.

MR. F. RILEY, charge engineer at the Ashton-under-Lyne Corporation electricity works, has been appointed to a similar position in the "Joint Board" generating station at Stalybridge.

The King's Lynn T.C. has appointed MR. C. JACKSON as chief assistant at the electricity works. MR. ADAM BROWN, of the Lincoln electricity works, has been appointed to succeed Mr. Jackson.

General.—MR. J. A. NEWTON, M.I.E.E., managing director of the J. A. Newton & Co. Propy., Ltd., electrical engineers of Melbourne, is now in this country on a visit. His address while in London is c/o Messrs. Allison Bros., 60, Gracechurch Street, E.C.

MR. JAMES BASTIAN, who has, until recently, represented Messrs. Rumney & Rumney in the Manchester district, has now been appointed by Messrs. Platinum Substitutes, Ltd., as their representative, in the United Kingdom, for the sale of their "Sineplat" conductor for incandescent lamps.

We are informed that MR. H. M. HOBART, M.Inst.C.E., has taken into partnership Mr. A. G. Ellis, who has been associated with him for several years, and that his consulting engineering practice will henceforward be carried on under the name of "Hobart & Ellis." Mr. Hobart hopes under this arrangement to be able to give more personal attention to matters at the works of clients, and to the supervision of tests and inspection of apparatus on behalf of purchasers. We congratulate both parties to the agreement.

Dr. Pöhl, having resigned his office as lecturer of electrical engineering at the Bradford Technical School, MR. W. G. GRIFFITHS, B.Sc., of Exeter, has been appointed in his stead, at a salary of £200 per annum.

Obituary.—A correspondent reports the death of MR. SAMUEL SHORROCK, of Darwen, which recently occurred in China. Mr. Shorrock, who succumbed to an attack of dysentery, first went out to China in 1897, starting business as a machinery importer and consulting engineer. Since 1903 he had dealt also in electrical supplies of every description, and as agent for Messrs. Bruce Peebles & Co., Ltd., he had to do with the securing for them of an important tramway concession. Prior to his removal to Shanghai he was a member of the firm of Messrs. J. & R. Shorrock, of Darwen. At the funeral there were present representatives of deceased's firm, the Municipal Council, Messrs. Bruce Peebles and Co., Ltd., the British Consulate and Supreme Court, all the principal hongs, the Stock Exchange, many Masonic brethren, and others.

We regret to announce the death of Engineer GIUSEPPE LANINO, who was born in Turin in 1832. He took a leading position for many years as one of the leading Italian engineers associated particularly with the construction of railways, and under his direction much of the electric traction work in Italy has been carried out.

NEW COMPANIES REGISTERED.

Bude Electric Supply Co., Ltd. (95,137).—This company was registered on October 7th, with a capital of £7,000 in £1 shares, to adopt an agreement with Christy Brothers & Co., Ltd., and to carry on the business of electricians, engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers are:—F. J. Thynne, 67, Eaton Place, S.W., J.P., D.L., with 200 shares; R. A. Foster-Melliar, Merkjasteinn, Bude, solicitor, with 100 shares; S. Pethick, 4, Burn View, Bude, builder, with 100 shares; Sir Charles T. Dyke Ackland, Bt., J.P., Killerton, Exeter, with 100 shares; H. I. Mackenzie, Granville Estate Office, Bude, land agent and surveyor, with five shares; W. W. Petherick, Stafford House, Bude, merchant, with 10 shares; and A. Saunders, Riverside, Stratton, boot maker, with five shares. Minimum cash subscription 3,000 shares. The number of directors is not to be less than three or more than seven: the first are F. J. Thynne, R. A. Foster-Melliar, S. Pethick and F. Christy, M.I.E.E.; qualification, 100 shares; remuneration as fixed by the company. Registered office, The Strand, Bude, Cornwall.

Acme Patent Fire Alarm Co., Ltd. (95,162).—This company was registered on October 9th, with a capital of £2,000 in £1 shares, to acquire the business of patent fire alarm manufacturers carried on by A. Goldsmith, G. Francombe and F. E. Ryall at 30 and 32, Albany Street, Kingswood, Bristol, as the "Acme Patent Fire Alarm Co." and to carry on the same and the business of electrical, mechanical and general engineers, electricians, instrument makers, suppliers of electricity, &c. The first subscribers are:—A. Goldsmith, High Street, Kingswood, Bristol, electrician, 100 shares; G. Francombe, 32, Albany Street, Kingswood, Bristol, electrician, 100 shares; F. E. Ryall, Deanery Road, Warmley, Glos., engineer, 100 shares; H. A. Blacker, 8, Zetland Road, Bristol, dairyman, 1 share; J. Jones, Homeside, Brislington, Bristol, manager, 1 share; F. Francombe, 3, New Queen Street, Kingswood, Bristol, manufacturer, 1 share; and R. Hawkens, 9, Burghley Road, St. Andrew's Park, Bristol, solicitor. No initial public issue; the number of directors is not to be less than three or more than seven; the first are A. Goldsmith, G. Francombe and F. E. Ryall; qualification, £100 shares or stock; remuneration, £50 per annum, divisible. Registered office, Two-Mile Hill, Kingswood, Bristol.

Glover-Lyon Ventilation Co., Ltd. (95,141).—This company was registered on October 7th, with a capital of £10,000 in £1 shares (2,500 5 per cent. cumulative preference) to adopt an agreement with T. G. Lyon for the acquisition of the business of a ventilating engineer carried on by him at 1, Victoria Square, Westminster, together with certain patents and property appertaining thereto, and to carry on the said business and that of electricians, mechanical engineers, suppliers of electricity, motive power and light, &c. The first subscribers (each with one share) are:—W. A. S. Hellyar, 26, Finsbury Pavement, E.C., solicitor; F. D. Pepper, 61 and 62, Chancery Lane, W.C., incorporated accountant; J. Manns, 17, Chichester Place, Brighton, gentleman; P. Bird, 3, Heathfield Gardens, Wandsworth Common, clerk; T. E. Lyon, M.D., 1, Victoria Square, S.W.; J. W. Lyon, 27, Cornhill, E.C., salvage broker; and E. G. Tyrrel, 23, Turney Road, W., Dulwich, S.E., clerk. No initial public issue. Registered without articles of association.

Christian & Phipps (1907), Ltd. (95,215).—This company was registered on October 12th, with a capital of £305 in £1 shares, to acquire the business carried on at 23, High Street, Hampton Wick, Middlesex, as "Christian & Phipps, Ltd.," and to carry on the business of electricians, mechanical engineers, manufacturers of electrical appliances and apparatus, workers of and dealers in electricity, motive power and light, &c. The first subscribers (each with one share) are:—A. Harden, Eagle House, Hampton Wick, yacht and launch builder; H. Myram, Fairfax Road, Hampton Wick, engineer; H. Harden, 2, Grove Lane, Kingston, gentleman; H. H. Sadler, 28, Munster Road, Teddington, engineer; Emma Drury, 3, Prince's Terrace, Holborough Road, Snodland, clerk; F. J. Harden, 25, The Crescent, Barnes, S.W., gentleman; and T. H. Hughes, 88, Station Road, Finchley, accountant. No initial public issue. The first directors are A. Harden and H. Myram; qualification, 100 shares; remuneration (if any) as fixed by the company. Registered office, 23, High Street, Hampton Wick.

I.T.E. Electric Co. (1907), Ltd. (95,222).—This company was registered on October 12th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, engineers, workers of and dealers in electricity, manufacturers of electrical apparatus, &c., and to adopt an agreement with the Cutler Electric and Manufacturing Co., A. E. Newton and W. M. Scott. The first subscribers (each with one share) are:—W. Gibson, 129, Grosvenor Road, Canonbury, N., electrical engineer; F. M. Jeboult, 9, Walbrook, E.C., solicitor; D. H. Jeboult, 9, Walbrook, E.C., incorporated accountant; W. J. Todd, 5, Buff Place, Camberwell, S.E., clerk; F. W. Cooper, 1, Stanmore Villas, Hadleigh Road, Leigh, Essex, clerk; T. M. Jordan, 96, Bonner Road, Victoria

Park, N.E., clerk; and T. H. Smart, Woodbine, Fallow Court Avenue, North Finchley, N., clerk. No initial public issue. The number of directors is not to be less than two or more than five. P. F. Huddleston is permanent governing director; special qualification, £100; qualification of ordinary directors (after termination of original management), one share; remuneration of governing director, £100 per annum; of other directors as fixed by the company. Registered office, 92, Finsbury Pavement, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Totnes Electricity Supply Co., Ltd. (62,693).—This company's annual return was filed on July 30th, when the entire capital of £10,000 in £1 shares had been taken up. £9,993 has been received, leaving £7 in arrears. Mortgages and charges: Nil.

Chilian Electric Tramway and Light Co., Ltd. (57,203).—This company's annual return was filed on August 23rd, when the entire capital of £1,150,000 in £1 shares (650,000 preference) had been taken up. £650,000 has been paid on the preference, and £500,000 is considered as paid on the ordinary. Mortgages and charges: £475,800.

Thomas Parker, Ltd. (40,973).—This company's annual return was filed on August 20th, when the entire capital of £75,000 in £10 shares had been taken up. £10 per share has been called up on 5,750, and £57,500 has been received. £17,500 is considered as paid on 1,750 shares. Mortgages and charges: £65,000.

Birmingham and Midland Motor-Omnibus Co., Ltd. (82,681).—£6,000 5 per cent. debentures, created February 22nd, and dated September 26th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holders: City of Birmingham Tramways Co., Ltd., and Birmingham and Midland Tramways, Ltd.

Electrical Publishing Co., Ltd. (London) (74,449).—Issue on September 25th of a £25 6 per cent. debenture, part of series created January 21st, 1907, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £600.

Wright & Wood, Ltd. (electrical engineers, Halifax) (93,878).—Particulars of £800 debentures, created by resolution of September 25th, 1907, have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Holman James & Co., Ltd. (83,604).—This company's annual return was filed on September 25th, when the entire capital of £300 in £1 shares had been taken up. £185 has been paid and £115 is considered as paid. Mortgages and charges: £1,200.

Chili Telephone Co., Ltd. (29,252).—This company's annual return was filed on August 10th, when 44,000 shares had been taken out of a nominal capital of £250,000 in £5 shares. £5 per share has been called up and £220,000 has been received. Mortgages and charges: £12,000 bonds to "Bearer."

London Electrical Fittings Co., Ltd. (62,468).—This company's annual return was filed on August 30th, when 2,999 shares had been taken up out of a nominal capital of £3,000 in £1 shares; £1,299 has been received and £1,700 is considered as paid. Mortgages and charges: Nil.

Electrolytic Alkali Co., Ltd. (Middlewich), (64,360).—Issue on September 23rd of £1,600 4½ per cent. first mortgage debentures, part of series created July 9th, 1904, to secure £50,000 charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £31,100.

W. H. Allen, Sons & Co., Ltd. (66,440).—This company's annual return was filed on September 6th, when 151,400 shares had been taken up out of a nominal capital of £200,000 in £1 shares. £1 per share has been called up on 1,400, resulting in the receipt of £1,400. £150,000 is considered as paid. Mortgages and charges: £50,500.

Jandus Arc Lamp and Electric Co., Ltd. (43,898).—This company's annual return was filed on October 2nd, when 2,041 shares had been taken up out of a nominal capital of £20,000 in £10 shares; £5 per share has been called up on 1,195 and £10 per share on 250, resulting in the receipt of £8,475; £5,950 is considered as paid on 596 shares. Mortgages and charges: £8,000.

Fleetwood and District Electric Light and Power Syndicate, Ltd. (49,666).—A deed of charge dated October 4th, 1907, to secure £750 and any further advances up to a total of £1,800, with 5 per cent. interest, has been registered. Property charged: The undertaking and assets of the syndicate (ranking in priority to charges created by a trust deed of October 31st, 1899). This charge is created by W. Cash (the Receiver appointed by the Court) pursuant to an Order of Court dated July 26th, 1907.

Consolidated Electrical Co., Ltd. (77,054).—This company's annual return, made up to July 29th, was filed on October 3rd. The entire capital of £125,000, in 110,000 ordinary and 15,000 preference shares of £1 each, has been taken up; £1 per share has been called up on 15,000 preference and 767 ordinary and 5s. per share on 109,248 ordinary, resulting in the receipt of £48,067 15s.; £31,932 5s. (15s. per share) is considered as paid on 109,248 ordinary. Mortgages and charges: Nil.

A. Reyrolle & Co., Ltd. (electricians, Hebburn-on-Tyne), (70,210).—Issue on October 3rd of £1,000 5 per cent. debentures, part of series created April 17th, 1907, to secure £20,000 charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £12,900.

British Hosiery and Electrolytic Bleaching Co., Ltd. (London) (86,337).—A memorandum of satisfaction in full of debentures, dated December 21st, 1905, securing £1,000, has been filed.

Malaga Electricity Co., Ltd. (48,076).—This company's annual return was filed on September 20th, when the entire capital of £57,000 in 10,000 ordinary shares of £5 each, and 7,000 ordinary shares of £1 each had been taken up. £50,000 has been paid on the ordinary shares, and £7,000 is considered as paid on the preference. Mortgages and charges: £44,738.

British Electric Traction Co., Ltd. (49,855).—This company annual return, made up to July 11th, was filed on September 27th. 133,301 ordinary and 161,437 preference shares have been taken up out of a nominal capital of £4,000,000 in 200,000 ordinary, and 200,000 preference shares of £10 each. £10 per share has been called up on 117,926 ordinary, and 142,500 preference shares, resulting in the receipt of £2,604,260. £343,120 is considered as paid on 15,375 ordinary and 18,937 preference. Mortgages and charges: £2,002,589.

Wisbech Electric Light and Power Co., Ltd. (93,430).—This company's annual return was filed on September 11th, when seven shares had been taken up out of a nominal capital of £45,000 in £1 shares. No calls have been made. Mortgages and charges: Nil.

Thomas' Patents, Ltd. (wire coverers, London) (85,084).—A debenture dated September 23rd, 1907, to secure £500 charged on the company's undertaking and property, present and future, including uncalled capital (if any), has been registered. Holders: Staffordshire Financial Co., Ltd., The Bridge, Walsall.

A. W. Penrose & Co., Ltd. (86,209).—This company's annual return was filed on August 27th, when 30,000 ordinary shares had been taken up out of a nominal capital of £40,000 in £1 shares (10,000 preference). £7 has been paid, and £29,993 is considered as paid. Mortgages and charges: £10,000.

CITY NOTES.

Cleveland and Durham Electric Power, Ltd.

THE directors' report submitted to the first annual meeting, held at Newcastle-on-Tyne on 9th inst., showed that during the period ended June 30th, 1907, ordinary shares in the Cleveland and Durham County Electric Power Co. and the Northern Counties Electricity Supply Co., Ltd., had been acquired at a cost of £611,373, and the sum of £28,770 had been expended in the construction and equipment of sub-stations, &c. A loan of £106,772 had also been advanced to the Northern Counties Electricity Supply Co. The net revenue for the period amounted to £10,978, out of which an interim dividend was paid in April last of 2½ per cent. on the amount called up on the preference shares, £2,351, leaving a balance of £8,626, which the directors recommended should be appropriated in payment of a further dividend of 2½ per cent. on the amount called up on the preference shares, as to £5,400, carrying forward the balance of £3,227. In January last the new power station at Grangetown was so far completed as to enable a commencement to be made in supply to the Tees district. Arrangements had been concluded whereby a supply in bulk was now being taken at Bishop Auckland, Hebburn and Felling, and a similar supply would soon be available at Blyth, Spennymoor, Hartlepool and Consett. It was expected that these would result in substantial reductions in the working expenses. The connections to the systems aggregated 9,172 H.P., as compared with 1,000 H.P. connected at June 30th, 1906. Mains had now been laid in Middlesbrough, Thornaby, Stockton, on the North bank of the Tees, and throughout a large portion of the Cleveland iron mines district and the coalfield in the Auckland district. Some 15 sub-stations had been erected, and others were approaching completion. An important extension of the mains system to the Hartlepools *vid* Seaton Carew was now in progress. Several new agreements had been made for the supply of energy for terms of years, which, when in full operation, should keep the plant available profitably employed. Important agreements had also been arranged with the Corporations of Middlesbrough and Hartlepool. The former were to take a bulk supply, and the latter were transferring their electric lighting provisional order to the Cleveland and Durham County Electric Power Co. for 42 years. The directors regretted to record the death of their colleague, Sir John D. Milburn, Bart.

MR. CHARLES EMMOTT, the chairman, who presided, said that shares issued to the public in July of last year of the nominal value of £700,000, had been subscribed to the extent of approximately £500,000. The final call on the preference and ordinary shares had been made since the close of the financial year, so that both classes of shares would now be paid. On the credit side of the accounts they would notice that the shares taken up in the Cleveland and Durham County Electric Power Co. amounted to about £443,000. This was a figure that would be constantly increasing, as the statutory company, under its Parliamentary powers, had actually to carry out the works which their company financed by taking shares in exchange. The investments in the second of their associated companies, viz., the Northern Counties Electricity Supply Co., amounted to about £167,000, and in addition to the shares they held in that company, they had advanced the company in loans the sum of about £106,000. Interest had been paid upon this loan. Besides the above investments capital expenditure on sub-station buildings, &c., had amounted to about £28,769. The net profit, after writing off £3,709 on account of formation expenses, was £10,977. Out of this, the directors proposed that the 5 per cent. dividend on the preference shares should be paid, carrying forward a balance of £3,226. The chairman sketched the technical developments which had been made by the company, and said the directors considered there was every reason to be satisfied with the progress which had been made during the short time since the incorporation of the company, both as regarded the amount of construction work carried out, and amount of new business obtained. When the statutory companies' undertaking was taken over in July, 1906, the business secured was only equivalent to about 1,000 H.P., to-day the contracts closed amounted to 12,000 H.P., a large proportion of which, it was anticipated, would be concluded on the same terms. Satisfactory as these figures were, only the fringe had been touched. From calculations they had made, the total requirements in the company's area reached about 225,000 H.P., the whole of which could, without doubt, in the course of time, be dealt with on terms which would be both profitable to the company and show substantial savings to the various power users whose works were included in this total. A matter of great importance to the Cleveland and Durham Electric Power, Ltd., was the application of electricity to rolling mills. It was no exaggeration to say that recent advances in this connection represented the most important development in the application of electricity to motive power purposes that had taken place during the last five years. This was much to say, in view of the fact that the applications of electricity in other directions had been so important, but a consideration of the magnitude of the iron

industry in this and other countries more than justified the assertion. It now appeared certain that electricity would replace steam for all rolling-mill work, the lightest as well as the heaviest, and this too, in the course of the next few years. As the Cleveland district produced between a quarter and a half of the iron of the United Kingdom, this development would eventually have an extensive and very favourable bearing on their company's progress. The chairman went on to say that, after lengthy negotiations with the Middlesbrough Corporation, the company had arrived at an agreement with them under which the Corporation took a large proportion of their requirements in bulk from them, and had given their consent to them supplying the considerable power-users in the greater portion of the industrial area of Middlesbrough. An agreement was also approaching completion with the Corporation of Hartlepool, which would enable the company for 42 years to actively develop the power and lighting business in Hartlepool, to reach which town the cables were at the moment being laid. So far as construction work was concerned, approximately 60 miles of underground cables had been laid, and 15 miles of overhead lines erected, while a further 40 miles were in hand. By means of these cables a supply was now within reach of practically every manufacturer in Middlesbrough, Stockton, Thornaby, and the adjoining districts, while a large number of the iron mines in the Cleveland district, and the collieries in the Auckland and Consett districts, were either being served or were within easy reach of the main cable arteries. In connection with the main system, 15 to 20 transforming substations had been erected, and were now in operation. Several others were in hand.

The report was seconded and adopted, and motions declaring the dividend on the preference shares, and reappointing the retiring directors and auditor, were carried.

Ferranti, Ltd.

The directors' report for the year ended June 30th, 1907, states that the profit on trading was £26,282, and after crediting discounts and interests and transfer fees, and deducting general establishment charges, repairs and renewals, legal expenses and directors' and trustees' fees, there remains a balance of £11,944, which has been applied as follows: Interest on prior lien debentures, £19; interest on first mortgage debenture stock, £5,000; interest on bank loan, £1,233; amount charged in respect of depreciation, £3,600; leaving a balance of £2,091, which sum has been deducted from the balance standing at the debit of profit and loss account at June 30th, 1906, reducing the net debit balance to £5,412. In view of the keen competition in the industry, and the high price of raw materials, the results for the year may be regarded as fairly satisfactory. The progress made by the various departments during the year is encouraging. Further improvements have been made in the works, and the general efficiency of the plant has been increased. In order to cope with the increasing business, the directors considered that it was necessary to obtain further working capital, and in March, 1907, meetings of the first mortgage debenture stockholders of the company were held, and their consent obtained to the creation of a prior lien charge to the amount of £20,000 on the property of the company. This issue has now been dealt with, and the effect of the increased working capital should be felt in the results of the current year. In order to assist the development of the business, the first mortgage debenture stockholders also agreed that the sinking fund on their debentures should not be payable until after December 31st, 1908.

British Thomson-Houston Co., Ltd.

Mr. J. F. Nauheim presided at the meeting of this company held at 83, Cannon Street, E.C., on October 10th. In moving the adoption of the report (see Electrical Review, October 4th), he stated that a year ago he expressed the hope that this report would be a more favourable one, but that hope had not been fulfilled—indeed, in the business of the year their expectations had been quite disappointed. Among the chief causes of this state of things, was the almost unprecedented rise in the price of raw material, while, on the other hand, competition had been so severe that it had been impossible to recoup themselves by raising prices. In addition to this, heavy traction business—the most important branch of their output—had come almost to a standstill in Great Britain. They had contracted during the year for 10 locomotives for the Metropolitan Railway Co. and for the electrical equipment of several trains, but this was practically all the heavy traction business done in Great Britain during the period under review, and he was sorry to say this condition of things continued. The balance-sheet showed that they had considered it right this year to make exceptionally heavy depreciations, and, in addition to the available profits, they had used for this purpose the amount standing to the credit of the premium reserve account. Their cash liabilities had been very largely reduced, and they were fortunate in being able to show large cash assets.

Mr. E. A. Carolan seconded, and the motion was carried unanimously.

Oriental Telephone & Electric Co., Ltd.—The directors have declared the following interim dividends:—3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income-tax, and 3 per cent. on the ordinary shares, free of income-tax. The warrants will be posted on 31st inst. The share transfer books will be closed from the 17th to the 31st inst.—both days inclusive.

Monte Video Telephone Co., Ltd.—The directors' report for the year ended July 31st last, shows, after providing for all working expenses in Monte Video and London, a net profit for that period of £20,384, as against £17,295 for the previous year. The interim dividends paid on May 1st last absorbed the sum of £3,616, leaving a balance of £16,768, to which should be added the sum of £2,383 brought forward from last year, making an available balance of £19,151. After transferring £6,000 to reserve fund, and £5,000 to reserve for renewal of plant, the directors recommend the payment of final dividends of 2½ per cent. upon the preference share capital, and 4 per cent. upon the ordinary share capital, making 6 per cent. for the year, and leaving a balance of £3,081 to be carried forward. There has been a marked increase during the year in the number of subscribers and in revenue. The address of the registered office of the company is now 325, Dashwood House, New Broad Street, E.C.

Rosario Electric Co., Ltd.—The report for the year ended June 30th states that the balance at credit of profit and loss account, after making provision for depreciation of buildings, plant, &c., and for expenses of issuing new capital, is £20,305, plus £2,767 brought forward, making a total of £23,072. A dividend of 5s. each on the ordinary shares is proposed, making 8 per cent. for the year, and there is added to the reserve fund £5,000, leaving £4,600 to be carried forward. To meet the increasing demand, the directors have ordered a seventh steam dynamo of 1,000 kw. A new arrangement has been made with the municipality for the supply of electric current for street lighting. The municipality has already ordered the necessary lamps, and the company is providing additional cables to supply these lamps and for general use.

Westinghouse Electric and Manufacturing Co.—the *Kölnische Zeitung* learns from Paris that the Société Générale is taking over from the Westinghouse Electric and Manufacturing Co. 14,000,000 fr. 5 per cent. 10-year notes with a three-months' option, to a further sum of 6.000,000 fr. The proceeds are to yield 7,000,000 fr. additional money to the French company, and to afford funds to the Russian company in connection with the introduction of electric traction on the tramways in St. Petersburg.—*Financial Times.*

Siam Electricity Co., Ltd.—At this company's meeting, held at Siam recently, Mr. W. Fleron Jacobsen, vice-manager, presided. The report recommended an interim dividend of 6 per cent. and Ticals 14 per share bonus. For the corresponding period last year 6 per cent. and a bonus of Ticals 5 per share was paid. The report was adopted. The chairman gave explanations of the purchase of the Siamese Tramway Co.'s shares.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in—

'Perak Rubber Plantations, Ltd.—25,000 vendors' shares of £1 each, fully paid, Nos. 50,001 to 75,000.

And to allow the following securities to be quoted in the Official List:—

Hastings and District Electric Tramways Co., Ltd.—40,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 40,000. (Renewed special application.)

The Committee have appointed special settling days as under:—

Wednesday, October 23rd.—Aluminium Corporation Ltd.—250,007 7 per cent. participating preference shares of £1 each, 15s. paid, Nos. 1 to 250,007.

United Serdang (Sumatra) Rubber Plantations, Ltd.—69,000 shares of £1 each, 15s. paid, Nos. 1 to 69,000.

Tuesday, October 29th.—Perak Rubber Plantations, Ltd.—25,000 vendors' shares of £1 each, fully paid, Nos. 50,001 to 75,000.

And ordered the undermentioned to be quoted in the Official List:—

Aluminium Corporation, Ltd.—250,007 7 per cent. participating preference shares of £1 each, 15s. paid, Nos. 1 to 250,007.

Woking Electric Supply Co., Ltd.—On page 581 of our issue of October 4th, when referring to the dividend for the half-year ended June, we stated that this was the first dividend on the ordinary shares. This was a mistake, the word interim being omitted. This is the first occasion on which an *interim* dividend has been declared, but dividends have been regularly paid on the ordinary shares for the last four years thus:—1903, 4 per cent.; 1904, 5 per cent.; 1905, 5 per cent.; and 1906, 5 per cent.

Melbourne Tramway and Omnibus Co., Ltd.—The report for the year ended June 30th last showed that after paying £57,600 in dividends for the year, making the necessary reserves, and including £25,711 brought forward from last year, there remained £40,391. From this a bonus of 3 per cent. was paid, and £25,991 was carried forward. The traffic receipts for the year showed an increase of £39,513. The increased traffic, representing the carrying of nearly seven millions more passengers, together with the advance in the rates of wages, had considerably increased the expenses.

Western Telegraph Co., Ltd.—The directors, after transferring £85,000 to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the marine insurance fund, and £10,000 to the land and buildings depreciation fund, recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1907, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance is carried forward. For the purpose of paying the above dividend and bonus on the 31st instant, the register of transfers will be closed from October 22nd to 30th, inclusive.

Pataling Rubber Estates Syndicate, Ltd.—Interim dividend, 2s. per share.

MARKET QUOTATIONS.

Wednesday, October 16th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	..
a ,, Oxalic .. .. per cwt.	33/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	42/-	..
a Ammonia, Muriate (crystal) .. per ton	£33 10	..
a ,, ,, ... per ton	£30	..
a Bleaching powder .. .. .. per ton	£5 10	..
a Bisulphide of Carbon .. .. per ton	£18	..
a Borax .. .. per ton	£16	..
a Copper Sulphate .. .. .. per ton	£24 5	..
a Lead, Nitrate .. .. .. per ton	£32	..
a ,, White Sugar .. .. .. per ton	£35	..
a ,, Peroxide .. .. .. per ton	£32	..
a Methylated Spirit .. .. .. per gal.	2/6	..
a Potassium Bichromate, in casks per lb.	3½d.	..
a Potash, Caustic (75/80 %) .. per ton	£20	..
a ,, Chlorate .. .. .. per lb.	3⅞d.	..
a ,, Perchlorate .. .. per lb.	9d.	..
a Potassium Cyanide .. .. per lb.	7d.	..
a Shellac .. .. per cwt.	220/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	..
Sulphur, Sublimed Flowers .. per ton	£6 10	..
a ,, Recovered .. .. per ton	£5 10	..
a ,, Lump .. .. .. per ton	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	..
a ,, Chlorate .. .. .. per lb.	3¾d.	..
a ,, Crystals .. .. .. per ton	£3 5	..
a Sodium Bichromate, casks .. per lb.	3d.	..
a ,, Cyanide (basis 100 %) .. per lb.	7d.	..
METALS, &c.		
b Aluminium Ingots, in ton lots .. per ton	£150	..
b ,, Wire, in ton lots .. per ton	£177	..
b ,, Sheet, in ton lots .. per ton	£163	..
p Babbitt's metal ingots .. .. per ton	£56 to £172	dec.
c Brass (rolled metal 2" to 12") basis per lb.	7d.	¼d. dec.
c ,, Tube (brazed) .. .. per lb.	9¼d.	¼d. dec.
c ,, ,, (solid drawn) .. per lb.	8d.	¼d. dec.
c ,, Wire, basis .. .. .. per lb.	7¼d.	¼d. dec.
c Copper Tubes (brazed) .. .. per lb.	10¾d.	¼d. dec.
c ,, ,, (solid drawn) .. per lb.	10¼d.	¼d. dec.
g Copper Bars (best selected) .. per ton	£63 5 to £63 10	dec.
g Copper Sheet .. .. .. per ton	£79	£6 dec.
g ,, Rod .. .. per ton	£64 5 to £64 10	dec.
e ,, (Electrolytic) Bars .. per ton	£64	£6 dec.
e ,, ,, Sheets .. per ton	£82	£4 dec.
e ,, ,, Rod .. per ton	£69	£5 dec.
e ,, ,, H.C. Wire per lb.	8¼d.	¼d. dec.
f Ebonite Rod .. .. .. per lb.	8/8	..
f ,, Sheet .. .. .. per lb.	8/-	..
n German Silver Wire .. .. per lb.	1/7	..
h Gutta-percha, fine .. .. per lb.	5/6 to 6/6	..
h India-rubber, Para fine .. .. per lb.	4/2½	dec.
Iron, Charcoal Sheets .. .. per ton	£18	..
,, Pig (Cleveland warrants) per ton	53/-	7½d. inc.
,, Forgings, according to size per ton	From £11	..
,, Scrap, heavy .. .. per ton	47/6 to 50/-	..
,, Wire, galvanised No. 8 .. per ton	£9 15	..
g Lead, English Ingot .. .. per ton	£19 5 to £19 10	£2 5 dec.
g ,, ,, Sheet .. .. per ton	£19 12 6	£2 5 dec.
m Manganin Wire No. 28 .. .. per lb.	8/-	..
g Mercury .. .. per bot.	£8 5	17/6 inc.
d Mica (in original cases) small .. per lb.	6d. to 1/-	..
d ,, ,, ,, medium per lb.	2/6 to 4/-	..
d ,, ,, ,, large .. per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.	1/2¾ to 1/4	..
p ,, rolled bars & rods per lb.	1/3½ to 1/5	..
p ,, ,, strip & sheet per lb.	1/5 to 1/7	..
o Platinum .. .. per oz.	110/-	..
e Silicium Bronze Wire .. .. per lb.	10d.	1½d. dec.
r Steel, Magnet, in bars	£60	..
g Tin, Block (English) .. .. per ton	£141 to £142	£19 dec.
n ,, Wire, Nos. 1 to 16 .. .. per lb.	2/-	1d. dec.
p White Anti-friction Metals—		
"White Ant" brand .. .. per ton	£45 to £70	..
h Zinc, Sh's (Vieille Montagne bnd.) per ton	£26	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Hobart Electric Tramway Co., Ltd.—The annual general meeting of this company was held in London on October 4th. Dr. A. Mattei presided, and, in moving the adoption of the report, he, according to the *Financial News*, congratulated the shareholders upon having at last reached the dividend stage. They were now able to declare a dividend of 5 per cent., for which shareholders had been waiting so long. The revenue had been steadily increasing for some time past, while the working expenses, especially the repairs to the permanent way, had considerably diminished. The permanent way and the rolling stock were in excellent condition. They had every reason to believe that the dividend would be maintained; indeed, the traffic receipts had increased so satisfactorily since the closing of the accounts that he thought he was justified in saying that they might look forward to a better dividend.

STOCKS AND SHARES.

Tuesday Evening.

THIS time the "Noes" have it. Since we last wrote, all the little cheerfulness, then noticeable, has worn off, to be succeeded by an all-round fall which degenerated into an acute slump in several markets, disorganising the rest in the process. Copper, as mentioned before, is one of the most disturbing features, but there are severe financial difficulties known to exist in New York, and the fear of tighter money as a consequence of this distress has acted as a drag upon Consols, and, through them, upon investment securities generally.

For the Home Railway department to be weak upon the reply of the directors to Mr. Richard Bell is natural enough. People will not buy stock during the present period of uncertainty. They tell their stockbrokers that if a strike should break out and prices were to fall severely, then they could send in their orders to buy. In this interval of waiting for the result of the men's ballot, however, the public hold their hands. Therefore quotations have to go down from lack of support, coupled with weakness caused by the terrible calamity at Shrewsbury, which made all prices in this market flat by sympathy.

So far as electrical stocks are concerned, there is actually a point rise to record in one of them, City and South London having hardened to 47. We believe it is correct to say that not another Ordinary stock in the whole Railway list shows an advance during the past week. Central London Ordinary has retrograded to 63, and the Deferred to 43½—this last being 3 down. Metropolitan gave way to 35, Districts to 10¾. Districts, it has been pointed out, have now come on to much the same line of quotation as London, Chatham and Dover Ordinary and Great Central Ordinary.

Marconi scares become more acute, or less acute, in accordance to the conditions prevailing in other markets. If the latter are depressed, then the cable companies, declares rumour, will be badly hit. If other sections are firm, the reports are quietly dropped, and telegraph stocks improve. This time, Marconi is to do wonders, and the shares of the company bearing his name are 1s. 3d. better at 18s. 9d. Cable stocks, on the other hand, have given way. Anglo-American Deferred, with a 30s. loss at 14¼, was one of those most hardly hit, but the other issues of the concern also suffered sharply. Eastern Telegraph and Eastern Extension have given way beyond the amounts of the dividends deducted last week, but Eastern 4 per cent. Debenture stock, to the excellence of which attention was directed here a week ago, added a point after its fall.

Telephone descriptions are dullest. The National Company's 4 per cent. Debenture stock eased off a point. Orientals were a shade lower. Monte Video Telephones keep steady upon a report showing substantial progress.

Reuter's shares are now quoted *ex* the dividend of 4s., but no alteration occurred in the price, which remains at 7½ middle.

Electricity supply issues are still unsensational. Edmundson's Preference fell ¼ to 1⅛, City Ordinary a like fraction to 9¼. County of London First Debenture stock moved up a little. Holders of London Electric Supply shares are watching with keen interest the progress of the electrification work on the part of the London, Brighton and South Coast Railway. The current will be drawn, at all events at first, from the London Electric Supply Corporation; the railway has decided not to build just yet a power station of its own. Underground Electric Railway Profit Notes fell 5 points to 51½. It may well be wondered how much further the fall in these Notes has to travel before the drop will be checked.

Traction stocks and shares are rather irregular. British Columbia Deferred rose 1 and the Preferred fell 1, from which it would appear as though holders of the latter were exchanging into the former. British Electric Traction Ordinary rallied after a further fall, and the Second Debenture stock has given way slightly. Calcutta Trams are *ex* 3s. 6d. dividend, but kept at 7¼, business being done at this figure last Monday. Mexico Tramways Gold Bonds have been fairly active round about 81, and Sao Paulo First Debentures were firm at 94. The Ordinary stock of Sao Paulo stands at 108½.

Manufacturing shares are so quiet as to call for no comment. Rubber issues continue to give way, and there is no spring left in prices. Iron and steel descriptions have been decidedly flat; the idea seems to be that the railway agitation may spread to this industry.

Indo-European Telegraph Co., Ltd.—The directors have declared an interim dividend for the half-year ending June 30th last, at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st. The transfer books will be closed from 18th to 31st inst.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Oct. 8th.	Closing Quotations Oct. 15th.	Business done week ended Oct. 15th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	2½%	3½%	3½%	54 — 57	52 — 55 xd	53	..	..	7 0 11
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5⅝%	6 %	6 %	97—100	93 — 96 xd	98⅜	93½	..	6 5 0
3,169,670	Do. do. do. Deferred ..	Stock	2s.	Nil	½%	1¾%	15½— 16	14½— 14⅝	15½	14	—1½	11 17 2
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6½ — 7½	6⅞ — 7½	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	£0 — £2	90 — 92	91	90	..	4 7 0
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6½ — 7½	6⅜ — 7½	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅞— 16⅞	15⅞— 16⅞	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3¾— 3¾	3¾— 3¾	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	10	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	9	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	12½— 13½	12 — 13 xd	12⅝	12	..	7 2 4
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	130 —131	128 —133 xd	132½	131	..	5 5 3
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	85 — 88	83½— 86½ xd	86¾	83½	..	4 0 11
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	100 —103	101 —104	103	102½	..	3 16 11
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	11½— 12½	11½— 12½ xd	12	11⅛	..	5 12 0
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	100	99	..	3 18 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½	97½—100½	..	..	..	3 19 7
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	102	101	..	3 18 5
181,127	Globe Telegraph and Trust	10	5⅛%	5⅝%	5⅛%	5⅛%	9½— 10½	9½— 10½	10	9⅜	..	5 4 9
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½	13½	12½	..	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	..	..	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	55 — 57	54 — 56	54	..	—1	5 16 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	64 — 67	64 — 67	..	..	..	5 4 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	64 — 67	64 — 67	..	..	..	5 19 5
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞— 1	⅞— 1⅛	20/-	18/9	+ ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1⅛— 1 1/16	1⅛— 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1— 1	1— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	106 - 108	107½	106½	..	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	106 —108	107½	106½	..	4 12 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10½— 12½	11	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¼— 5½	5¼— 5¼	5⅛	5¼	..	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..	3 1 3
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	100 —102	..	..	—1	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6⅜%	6⅜%	7 %	7 %	1⅛— 1⅜	⅞— ⅞	24/4½	..	— ⅛	5 9 10
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 1/16— 1⅛	1 1/16— 1 1/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	93	92½	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	7⅞	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	124 —127 xd	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6½— 7½	6⅜— 7½	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5⅜	..	..	..	4 10 11
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	..	12¼— 13½	12¼— 13½	13	12½	..	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞— 1	⅞— ⅞	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 % †	6 %	5 %	8 %	7½— 7⅝	7 — 8	7	..	..	10 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6¾— 7⅛	6¾— 7⅛	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 - 102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	7⅞— 8	7⅞— 8	7⅛	7⅛	..	5 0 0
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5⅛— 6⅜	6⅛— 6⅜	6⅜	6	..	4 8 11
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	103⅛	..	..	4 15 8
830,000	Babcock & Wilcox, 1 to 830,000..	1	17 %	20 %	20 %	20 %	3⅜— 3⅝xd	3⅜— 3⅝	77/6	72/6	..	5 3 3
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	3 16 10
88,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	7 %	7 %	7 %	4 — 5	4 — 5	..	..	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4⅞— 5⅛	4⅞— 5⅛	..	..	..	6 10 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4⅜— 5	4⅜— 5	..	..	..	6 0 0
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾— 4⅛	3¾— 4⅛	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5⅜%	96 — 99	96 — 99	..	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	130 —135	131 —136	132½	..	+1	4 8 3
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	113 —117	112 —116	115	..	—1	4 6 2
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —107	104 —107	105	104½	..	4 15 6
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —103	98 —101 xd	101½	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1⅜— 2⅛	1⅜— 2⅛	48/3	36/3	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	5⅛— 6	5⅛— 6	5⅛	5⅛	..	10 0 0
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	97 —100	96 — 99	97⅛	96	—1	5 1 0
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾— 7	6¾— 7	6⅞	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	62 — 67	62 — 67	..	..	..	5 19 5
50,000	‡ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅝— 1⅛	⅝— 1⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	67 — 70	67 — 70	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅞— 4 1/16	4⅞— 4 1/16	91/-	90/-	..	3 4 0
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
18,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛ xd	7⅛	7	..	5 6 8
80,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅜	9⅜— 10⅜	10⅛	9⅛	..	7 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅛	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107⅛	105½—107⅛	..	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛— 1 1/16	1⅛— 1 1/16	25/3	25/-	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	98 —102	100½	97	+ ½	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	63 — 65	62 — 64	63½	62	—1	6 5 0
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	88 — 90	88 — 90	88	..	..	4 8 11
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	45 — 48	43 — 46	43	..	—2	8 14 0
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2⅜%	45 — 47	46 — 48	46½	..	+1	4 8 7

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Oct. 8th.	Closing Quotations Oct. 15th.	Business done week ended Oct. 15th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s.
85,000	Crompton & Co., Nos. 1 to 85,000	* 3	2¼%	2½%	2½%	5 %	1⅞— 2	1⅞— 2	38/1½	..	..	7 5 5
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	98	97½	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1¼— 1½	1¼— 1½	..	..	..	6 13 4
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1¼	22/6	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅝— 13⅜	12⅝— 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1 1/16— 1 1/16	1 1/16— 1 1/16	22/6	20/7½	..	9 8 3
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	2¼— 2⅜	2¼— 2⅜	42/6	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90 xd	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16— 3/32	1/16— 3/32	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	3/32— 1	3/32— 1	17/6	12/6	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	6⅞ xd	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1¼— 1⅜	1¼— 1⅜	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½— 10⅝	10½— 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11 — 12	11 — 12	..	..	..	6 5
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105½—107½	105½—107½	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14½— 15½	14½— 15½	..	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1⅝— 1¾	1⅝— 1¾	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅛— 8	7⅛— 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 0 0
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞— 8⅜ xd	7⅞— 8⅜	8¼	..	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	83	82	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16— 3/32	1/16— 3/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	27/32— 31/32	27/32— 31/32	17/9	..	..	5 2 7
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	94	..	..	4 10 11
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/32— 3/32	1/32— 3/32	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32— 5/32	3/32— 5/32	14/-	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	30 — 32	30 — 32	..	..	..	5 13 2
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	55 — 58	48 — 53	48	..	— 6	9 8 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1⅛— 1⅜	1⅛— 1⅜ xd	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅞— 4⅛	3⅞— 4⅛ xd	76/3	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	74 — 78	74 — 78	76½	76	..	5 2 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅝— 5⅛	4⅝— 5⅛ xd	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅞— 8⅛	7⅞— 8	..	..	..	6 13 4
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	4 4 10
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅝— 4⅛	3⅝— 4⅛	..	..	..	6 1 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3¾— 4	3¾— 4	..	..	..	5 12 6
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝— 3⅞	3⅝— 3⅞	..	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾— 4⅛	3¾— 4⅛	77/6	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	8⅝— 9⅝	9⅛	9 1/32	— ¼	6 3 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10¾— 11⅛	10¾— 11⅛	10¾	..	..	5 4 4
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 — 100	97 —100	..	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅛— 5	3⅜— 4⅞	..	..	— ⅛	3 7 4
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5	4⅞— 4⅞ xd	..	..	— ⅛	6 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6⅝— 7⅛	6⅝— 7⅛	..	..	..	6 9 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 11	10 — 11	10¾	..	..	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	107 —110	109	..	+ 1	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛— 1	⅛— 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1⅜— 2	1 — 1⅜	30/-	..	— ½	8 11 5
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6¾— 7⅛	6¾— 7 xd	..	..	— ¼	6 8 7
21,000	Kensington and Knightsbridge Electric Ord.	5	12½%	12 %	10 %	10 %	8¼— 9⅛	8¼— 9⅛	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1¾— 1⅞	1¾— 1⅞	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛— 4⅜	4⅛— 4⅜	..	..	..	6 6 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 93	89 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝— 5⅛	4⅝— 5⅛	5⅝ 98/9	5⅛ 95/-	..	4 7 10
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 10 0
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	6¼— 6⅝	6¼— 6⅝	..	..	..	5 18 6
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,810	5	6½%	7 %	7 %	7 %	5½— 6	5½— 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅛— 8⅛	7⅛— 8⅛	7⅞	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅝— 7⅜	6⅝— 7⅜	..	..	..	4 14 11
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅞— 2⅛	1⅞— 2⅛	..	..	..	6 6 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜— ⅝	⅜— ⅝	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1 — 1⅛	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜— 2⅛	1⅜— 2⅛	..	..	..	11 10 6
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝— 2⅛	1⅝— 2⅛	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	92 — 95½	92 — 95	..	..	..	4 14 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8⅛— 9	8⅛— 9⅛	8⅛	..	..	6 9 9
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4⅝— 5⅛	4⅝— 5⅛	97/6	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent., August 15th, 1907.

THE CONCEPTS AND TERMINOLOGY OF ILLUMINATING ENGINEERING.

The Illuminating Engineering Society of America has so far perfected its organisation that it has held its first annual Convention at Boston. The proceedings commenced on July 30th, with a presidential address delivered by Dr. Clayton H. Sharp on the subject which forms the title of these notes. Inasmuch as he introduces to general notice ideas and terms concerning the science of illumination which, while well understood in scientific circles, have not yet received the attention they deserve in ordinary practice, the address is of considerable value to engineers who are engaged in the scientific illumination of buildings and streets, and for this reason a *résumé* of his statements may not be without value.

He commences with the obviously true statement that the terminology of a science always lags far behind the actual state of the science itself. As long as the treatment of the science is quantitative only, no particular need is felt for exact terminology. As soon, however, as accurate measurements of quantities pertaining to the science become necessary for the carrying out of the practical ends of such knowledge, the need for terms correspondingly precise is felt. For example, in the earlier days of the science of mechanics no strict difference was made in using the terms force, work and power; at the present time, of course, these ideas and terms are very clearly defined. The above statement is as true for an applied science as it is for a pure science. In the application of the scientific principles of industrial production to the uses of every-day life an empirical method is usually adopted. Conceptions of methods of work at first are inexact and hazy, becoming clear with time and bringing in their train careful terminology. It was very many years before the terms used in electricity became in any sense exact or systematised. When, however, electricity emerged from a pure science to its application to the practical problem of artificial illumination, so that electric power became a commercial product, the need for units of measurement, measuring instruments and terms all became apparent, and such words as volt, ohm, ampere and watt became every-day language to the workers in this sphere. In magnetism, again, the first investigators expressed their ideas in terms of pole strength, while later, when magnetic calculations became an integral part of the design of dynamos and motors, the pole-strength basis of calculation was abandoned in favour of magnetic flux.

The position in regard to illuminating engineering is that, although the science of optics is in many cases exact, it has remained in a rudimentary condition in so far as terminology and concepts relating to light as an output used for purposes of illumination are concerned. A distinct parallel occurs between the old conception of magnetic pole strength and the present method of estimating light in candle power. The strength or intensity of light sources has been the principal idea in dealing with light as a product. This conception itself has emerged from candle-power in a given direction to the assumed "mean spherical candle-power," which is a distinct advance, since it implies the recognition of the difference between the candle-power in a given direction, and the average candle-power in all directions in space. Moreover, the notion of intensity of a luminous source has become a familiar one.

Now, in determining the lines of future development, it must always be remembered that the practitioner must feel the need of some novel term or idea before he will adopt it. At the present time in quantitative work, the illuminating engineer deals in terms of candle-power and intensity of illumination, but has no terms expressing directly the quantity of light which is being emitted by the source with which he is dealing. This is rather surprising, because the quantity of light which he has at his command is vital, whereas the distribution of light can be arranged by the use of various devices. Now light consists of ether waves with a velocity of 300,000 kilometres per second; the source of light is simply a wave maker. If this source be enclosed by an imaginary sphere the total flow of ether vibrations through its surface measures the luminous output from the source. For the sake of uniformity in the nomenclature with other branches of physics, the Latin term for flow, namely, flux, is used. The output of any lamp then is measured by the total luminous flux emitted, and the brilliance of a reflecting or transmitting surface is proportionate to the luminous flux emitted by the luminous area. The reflecting or transmitting power of such a surface is the ratio of the luminous flux emitted to that received, and the intensity of the illumination on any surface is the flux received per unit area.

To establish a relation between the unit of luminous flux and the unit of luminous intensity, which is the candle-power, unit flux is defined as the flux emitted by light of unit intensity, that is to say, 1 c.p., in a unit solid angle. The unit solid angle is the angle subtended at the centre of a sphere by a portion of the sphere bounded by four lines, each equal in length to the radius of the sphere. There are 4π, or 12·57 solid angles in the entire sphere, hence approximately a unit solid angle is one subtended at a point by a surface 1 ft. sq. 1 ft. distant from that point, or 1 metre square, 1 metre distant from that point. If at the apex of such a solid angle a source of light of 1 c.p. be placed, unit luminous flux will pass through a transverse plane in the solid angle without reference to the inclination of the plane, or its distance from the light. Since there are 4π solid angles in a sphere, the total flux from the source of light at the centre of the sphere will be 4π, or 12·57 times the mean spherical candle-power of the source.

The intensity of illumination at any surface is measured by the luminous flux per unit of that surface or by the flux density. From this relation the former inverse square law may be at once deduced, and it is of practical help in computing average illumination results. If, for example, we know that from a given source or sources of light, a certain flux falls upon the plane of reference, the average illumination of this plane is at once determined by dividing the flux by the area of the plane, the average illumination being thus determined without direct reference to the candle-power of the source. Conversely, measurements of illumination at a given plane enable us to determine the flux of light falling on that plane. We can thus determine the net efficiency of light, which is the relation of flux which falls upon the horizontal plane of reference to the total luminous flux emitted by the lamps in the room.

When we wish to get average values for illumination rather than exact illumination curves, we may, ignoring the candle-power and distribution of the luminous intensity of the lamp, start out from the value of light flux which the lamp, together with its reflector or globe, sends in the direction of the plane of reference; multiplying this figure by the number of lamps and dividing by the area of the plane, we have approximately the illumination of the plane, neglecting reflections. The effect of the reflections by the walls of the room on the flux is obtained by multiplying the flux by $\frac{1}{1-\kappa}$, where κ is the average coefficient of reflection of the walls and ceilings. The advantage of this procedure is that it gives an average value for illumination over the entire plane of reference without going through the calculation of actual illumination at a large number of points. The well-known Rousseau diagram for the determination of the mean spherical candle-power is merely a flux diagram. If it extends over 180°, the area enclosed is proportionate to the total flux of light and the area of any angular portion is proportional to the flux in that solid angle or zone. The Matthews integrating photometer may be calibrated so as to give directly the total luminous flux from a lamp measured by it, and it is, therefore, seen that by the use of such devices as are available to-day it will be easy to rate lamps according to their radial flux, rather than their total candle-power.

At present the unit of luminous intensity is usually called the candle-power. The distance in England being measured in feet, the unit of illumination is sometimes called the candle-foot, and sometimes the foot-candle. The plural may be candle-feet or foot-candles, but the foot-candle or the candle-foot means the quantity divided by not the foot, but feet squared. Therefore, the term is doubly inappropriate. Using the metric system, the metre is taken as the unit of length, and the illumination produced by one candle at the distance of one metre is called the lux. Now a unit of lux

depends only upon the unit chosen for luminous intensity, and a name which has already been suggested and used for this purpose is the "lumen." By this term is meant the flux of light emitted by the source of one candle-power through a solid angle of unit dimensions. The number of lumens falling on the surface divided by the area of the surface in square feet gives the illumination in foot-candles.

With reference to the term efficiency in illumination, we have, first, the efficiency of illumination as such; secondly, efficiency of the illumination installation or the efficiency of the utilisation of the light; and, thirdly, the efficiency of the installation including the lamps, or the gross efficiency of the installation. The efficiency of an electric lamp would be determined in lumens per watt, instead of as at present in watts per candle. Thus specific consumption would be measured by watts per lumen. What we ordinarily at the present day call a 16-C.P. 3·1 watts per candle lamp, would under the new system have a rating of 163 lumens, and an efficiency of 3·3 lumens per watt. The net efficiency of the installation irrespective of the lamp may be expressed in terms of lumens received on the horizontal plane of reference divided by the total lumens emitted by the lamps; the gross efficiency, in which the man who pays the bills is most interested, is expressed in terms of lumens on the plane of reference per watt expended in feeding the lamps. It is seen that the expression of foot-candles per watt per square foot which is sometimes used at present as an expression for the gross efficiency of an installation is, really, foot-candles multiplied by square feet and the total divided by watts; but foot-candles multiplied by square feet gives the luminous flux in lumens, and hence foot-candles per watt per square foot equal numerically lumens per watt, which is a much simpler expression to use.

THE SPARKING-COIL CONDENSER.

It is very generally said that the object of the condenser used with a sparking coil is to "look after the extra current." If that is the one duty of the condenser, why are not as good results obtained with the condenser connected across the primary winding as across the interrupter?

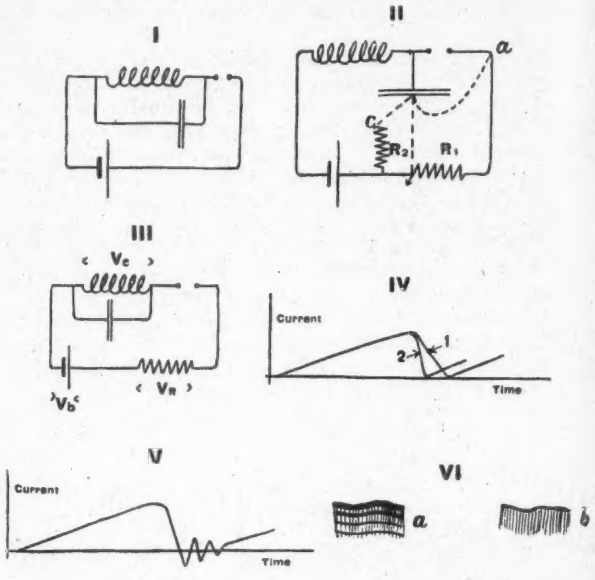
As is seen from fig. 1, with the condenser across the primary, it will at the moment of break be charged to a small P.D. in such a way as to help the "extra current" flow round the local circuit formed by itself and the primary, and so it would seem to look after the "extra current" just as well as if it were connected across the interrupter.

The term "extra current" is really a misleading one, as neither current nor even a quantity of electricity is stored up in the coil; the object of the condenser is to quickly stop the self-induced current; it does this first by offering an easy alternative path to that through the interrupter, thus allowing the arc there to go out, and consequently high resistance is introduced at the interrupter; there is still a circuit through the primary and condenser, but, as its capacity is small, there must be a rapid change of current, which results in the required high E.M.F. in the secondary.

A few experiments were carried out to determine the effect of connecting the condenser to different points of the circuit. The coil used was a 2-in. spark coil with plain trembler interrupter. The efficiency of any arrangement of the condenser was judged by the maximum distance the secondary spark would continually jump.

It was found that with any resistance in circuit except that of the coil itself, it was better to have the condenser across the interrupter than across the primary; on reducing the resistance of the circuit until the coil was carefully connected with short leads to two big accumulators, it was found that either position of the condenser gave practically the same results.

Inserting a resistance R_1 (fig. 2) between the battery and interrupter, a better spark was obtained with the condenser across the interrupter than across the interrupter and resistance. In the first case the current at break has to flow through the resistance R_1, while in the second case it does not as the condenser is in parallel with the resistance. To see whether this was the cause of the difference in the secondary spark, a second resistance R_2, equal to R_1, was put in series with the condenser, and the two put across the interrupter



and R_1; this arrangement gave a worse result than the other two. Referring to the diagram (fig. 2) connection *a* gave the best result, then followed *b*, and *c* was the worst. Also if a resistance R was connected in series with the condenser, the smaller R was the better the spark, whether the two were connected across the primary, interrupter, or interrupter and another resistance. The difference in the two cases above, cannot, therefore, be due merely to the current at break in one case having to flow through a resistance. Another case, which at first sight would seem to show that resistance is needed in the condenser circuit, is that with a resistance between the battery and primary a better spark is obtained with the condenser across the primary and resistance than across the primary alone.

A probable reason, with which all the results obtained agree, for the secondary giving the best sparks with the condenser connected straight across the interrupter, is that only when the condenser is in this position is there a moment of zero P.D. across the interrupter at the time of breaking with a decreased current through the interrupter. When the condenser is straight across the interrupter, at the moment of breaking there will be practically no P.D. across the interrupter, but a large decrease of current through it owing to the current passing into the condenser. If, however, the condenser is connected to *b* (fig. 2), that is, across the interrupter and resistance, then at the moment of breaking there is a P.D. across the condenser, tending to keep the current flowing through the interrupter. The case when the condenser is across the primary is best seen by considering the instantaneous voltages in the circuit; immediately before the moment of breaking, there will be the voltage v_b of the battery (fig. 3), v_R of the resistance, and v_c of the condenser or of the primary; now $(v_b + v_R + v_c)$ must equal zero, assuming R to be the total resistance of the circuit external to the primary winding; but directly the circuit begins to open, and the current through the interrupter to die away, v_R will get less, and there will be a resultant voltage across the interrupter.

A high-frequency Duddell oscillograph was used to obtain some records of the current in the primary winding. The method employed to obtain a steady wave was to make the circuit every revolution, at a definite position of the motor armature which drove the oscillating mirror; the first wave was thus always in the same position on the tracing desk.

In fig. 4 are given two curves showing the effect of connecting the condenser (about ·75 M.F.) across the interrupter; curve 1 is the current without the condenser, and curve 2 that with the condenser; it will be seen that the current dies away much faster with the condenser than without; the curves also show that an ordinary size condenser does not affect the current at "make" owing to any oscillatory current, the two curves being taken with the secondary open, which is the best condition for oscillatory currents in the primary; with a condenser of 2·5 M.F., which is far too large a capacity for the efficient working of the coil, an oscillatory current was produced in the primary, but even then the oscillations had practically died away before the next "make" (fig. 5).

The secondary was giving about ½ in. spark when the curve in fig. 5 was taken; the spark was a much fatter one than could be obtained with the smaller condenser though the maximum length obtainable was less. This fatness is due to the oscillatory current in the primary; the steepness of the oscillations on the curve is large, though the amplitude rapidly diminishes, so that instead of one spark at each break, there are with the larger condenser really several sparks. This was confirmed by observing the reflection of the sparks in a revolving mirror, when in the case of the larger condenser each spark appeared broken up into four or five separate sparks, while with the smaller condenser only one spark could be observed, although the way in which it was drawn out indicated its greater duration. Fig. 6 is an attempt to give the appearance of the sparks in the revolving mirror, (*a*) being with the large and (*b*) with the smaller condenser. Even with the larger condenser, although the primary current was oscillatory the secondary current was clearly seen to be unidirectional by the distinctive colouring of the spark at the two electrodes and also by deflecting the spark by means of a magnetic field; this is probably due to large secondary magnetic leakage.

THE ELECTRICAL DECOMPOSITION OF WATER.

The apparatus put on the market for this purpose by the Maschinenfabrik Oerlikon, and recently described in *Elektrotechnik und Maschinenbau*, consists of a number of cells formed between ribbed cast-iron plates, shaped as shown in fig. 1.

The plates are provided with a continuous projecting rim, about 1¼ in. wide, on which a rubber band fits, so that when two such plates are pressed together an air-tight cell is formed between them. The rubber band also serves to insulate the two plates from one another, and these form the electrodes of the cell, and are further separated by a woven asbestos diaphragm.

Different numbers of such cells, according to the supply voltage, are clamped together in a press, as shown in fig. 2. Each cast-iron plate is provided with three holes (fig. 1). The front ribs of the plate open into one of the upper holes by means of a narrow slot, and the back ribs are similarly connected to the other upper hole. When the cells are built up together the holes form three canals—one upper one serving to collect the gas given off on one side of the plates (oxygen), and the other upper one the gas given off on the other side of the plates (hydrogen), whilst the lower canal is used to supply the water consumed.

About 2·4 volts is allowed per cell, and sets of 28, 48 and 96 cells in series are made up for 65-volt, 110-volt and 220-volt supply respectively. Four sizes of plate are made, viz., for 20 amps., 40 amps., 75 amps. and 125 amps. The smallest apparatus (65 volts, 20 amps.) takes about 9 gallons of electrolyte to fill the cells and produces 7·4 cb. ft. of hydrogen and 3·5 cb. ft. of oxygen per hour. The largest apparatus (220 volts, 125 amps.) takes 200 gallons of electrolyte and produces 158 cb. ft. of hydrogen and 79 cb. ft. of oxygen per hour. To produce 1 cb. ft. of oxygen and 2 cb. ft. of hydrogen per hour requires, therefore, about ·34 KW., and involves the decomposition of about $\frac{1}{10}$ gallon of water. These values are based on a temperature of 40° C. At a higher temperature (not exceeding 60° to 70° C.) the efficiency is somewhat improved.

The electrolyte used consists of a 10 per cent. solution of potash. A starting resistance is provided for insertion until the gases are being freely given off, and a switch enables several of the end cells to be disconnected when desired, so as to enable the current to be efficiently regulated.

If the apparatus is worked at its rated current and at a temperature not under 40° C., which it attains automatically when at work, the gases are given off in a fairly pure state—the oxygen containing not more than 2½ per cent. to 3 per cent. of hydrogen, and the hydrogen not more than 1 per cent. of oxygen. For a short time after starting up, however, the gases are not pure, and should be allowed to escape freely. As a rough indicator for purity, two glass tubes like gauge glasses are provided in the two gas chambers. These tubes end in small mouthpieces placed close together, one giving off hydrogen and one oxygen. The mixed gas is lighted at these mouthpieces, and burns quietly; but whenever there is any impurity, back-firing will occur into the tubes. The explosions are only slight, and are prevented from reaching the main chamber by the water which half fills the gauge glasses. In the larger installations, however, apparatus for analysing the gases is provided.

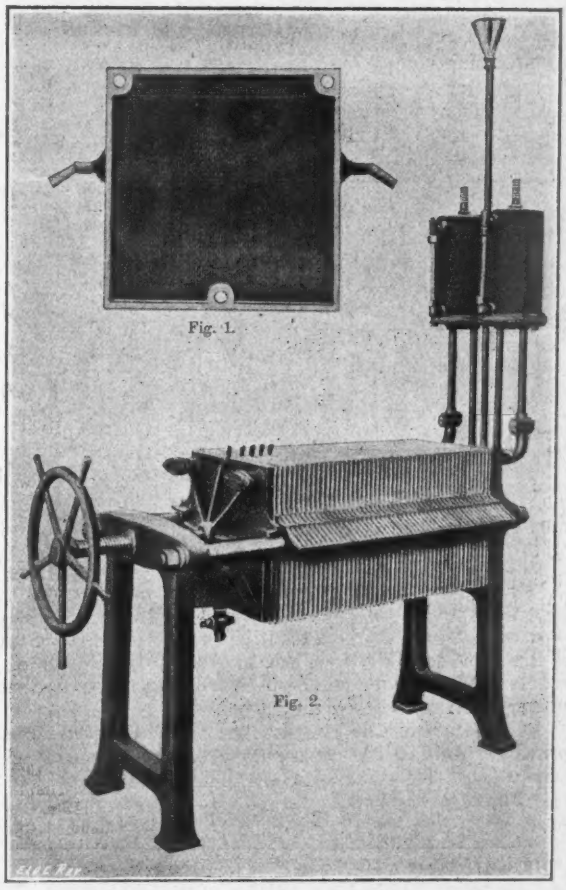


Fig. 1.

Fig. 2.

FIGS. 1 AND 2.—ELECTROLYTIC APPARATUS FOR WATER.

The standard construction enables the gases to be collected under a pressure of about ¼ atmosphere, while with slight modifications it can be arranged for pressures up to 2½ atmospheres.

If the gas is required continuously, it can, of course, be collected directly from the apparatus (after passing through a separator for moisture), but usually it is more convenient to provide gasometers.

No attention is required beyond supplying the necessary water, although it is advisable to clean out the cells every two or three months when in continuous use.

The cost of a cubic foot of oxygen produced by this

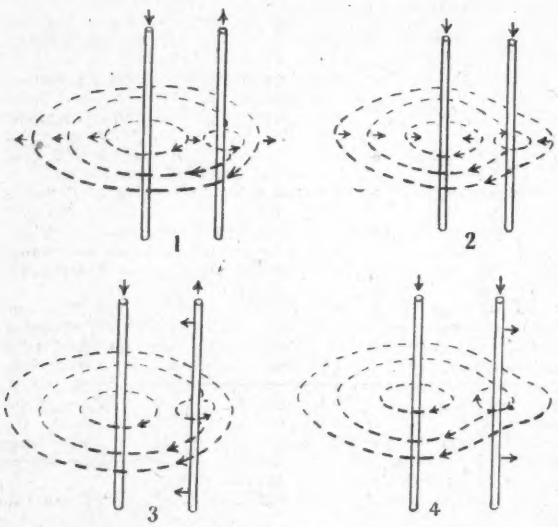
apparatus compares favourably with that of oxygen sold under pressure in steel bottles, so long as the cost of electric power does not exceed 3d. per B.T.U. The chief use to which the gases are put at present is in the oxy-hydrogen blow-pipe for brazing, lead-burning, &c.

THE DIRECTION OF INDUCED CURRENTS.*

By H. L. KIRKER.

Various schemes have been devised to aid in remembering the relations between direction of induced current and motion of a conductor in a magnetic field. In one of these, Ampere's rule,† the analogy of a figure swimming in a current is used; in another, Fleming's rule,‡ the relations are given by placing the thumb and first two fingers of one of the hands in certain positions. Personally, the author never liked Ampere's rule, nor did he find Fleming's rule quite satisfactory. There was always the liability of forgetting the position of the swimmer with relation to the magnetic needle, and it was difficult to keep in mind which finger of the hand corresponded in direction to lines of force, motion, &c.

It was not difficult to remember that parallel currents flowing in the same direction attract one another, and flowing in the opposite direction repel. Likewise there was no difficulty in grasping the assumption that current is encircled by rotating lines of force, and that the relation of the direction of the magnetic lines to the



Figs. 1 to 4.

direction of the current in the wire is that of right-hand rotation and forward travel of a corkscrew. Starting with these simple assumptions concerning the magnetic properties of currents, the author found (some twelve years ago) that if he assumed the encircling magnetism to be a magnetic whirl or vortex, and if these encircling lines came into the neighbourhood of another wire they meld back from jumping across the wire, thus forming a bend or dent in the vortex, which dent became an incipient vortex around the neighbouring wire, an immediate indication was given of the direction of induced current.

For example, if a current is sent down the main wire in fig. 1 a magnetic vortex is set up around the wire. As the vortex enlarges it strikes the neighbouring wire and forms a dent as shown. If, now, this dent in the expanding vortex is considered as the beginning of a vortex around the second wire, the direction of rotation of this incipient vortex is counter to the main vortex. In this particular case the direction of the magnetic whirl around the main wire is clockwise, and that around the second wire counter-clockwise, which means that the main current is flowing down, and the induced current up.

If the main current is interrupted, it may be seen, by referring to fig. 2, that the contracting vortex is dented out when it encounters the second wire. If, as before, the dent is considered as an incipient vortex, it will be seen that the direction of rotation is the same as the main vortex, which means that the induced current is flowing in the same direction as the main current.

Likewise, if it be assumed that a steady current is flowing in the main wire and a second wire is brought near, as in fig. 3, the direction indicated by the dent shows that the induced current is opposite to that in the main wire. Also, if the second wire is moved away, as indicated in fig. 4, the dent shows that the induced current is in the same direction as the main current.

If, in addition to the assumption that a wire carrying a current is the axis of a magnetic vortex, it is assumed that neighbouring vortexes rotating in the same direction tend to merge, and those rotating in the opposite direction tend to push apart, a simple mental picture may be obtained of the attraction of parallel currents flowing in the same direction and the repulsion of those flowing in opposite directions.

* *The Electric Journal.*

† "If one imagine himself swimming with the current and facing the needle, the north-seeking pole will always be deflected towards his left hand."

‡ "Let the forefinger of the right hand point in the direction of the magnetic lines; then turn the thumb in the direction of the motion; the middle finger, bent at right angles to both thumb and forefinger, will show the direction of the induced E.M.F."

LABOUR CONDITIONS IN AMERICAN ENGINEERING WORKS.

Cassier's Magazine for July and August contains an interesting article by an English workman who spent some 2½ years in American machine shops.

Mr. Livermore, the workman in question, endeavours to make us fully acquainted with the conditions obtaining in American engineering works, more particularly as regards the provision made for the comfort and well-being of the employés.

The space set apart for lockers and washing accommodation is a prominent feature in American shops and one which is demanded by the workmen themselves. The latter never appear in the streets without having first washed and discarded their working clothes or overalls, and outside the works the appearance and behaviour of the American mechanic in no way distinguishes him from his "bosses." In this country, on the other hand, any arrangements for the men to wash and change before leaving the works have been initiated by the employers, and at present the majority of the workmen prefer to carry out these operations in their homes. Signs are not wanting, however, that we are drifting towards American (and Continental) practice in this respect, and in future allowance must be made for this feature in laying new works.

The practice of providing a time recording clock in each department seems to be almost universal in American works, and the men have to reach their own shop on time. No grace is allowed as in English shops, and if a workman is late, an hour has to be forfeited. This plan of taking the men's time in each department is compared to the British method of checking the coming and going of all employés at one point, but here, again, our practice is undergoing a change, and many up to-date English undertakings are provided with recording clocks in each shop.

The American draughtsman is said to be much more closely in touch with the machine operators than his British confrère, and frequently may be seen taking notes on the working of a machine with a view to future improvements. This point is worthy of the most careful consideration by British employers. We doubt whether the English draughtsman always evinces a desire to improve upon his designs in this way, but it must be admitted that his employers have given him little encouragement. We remember an instance illustrating this contention:—In a large electrical engineering works it was at one time the custom for the draughtsmen to walk through the shops in the dinner hour or after the cessation of work in the afternoon with the intention of examining the machines for which they had made the drawings, and to improve their knowledge generally. This practice was put a stop to by the management for fear that the draughtsmen should become familiar with their manufacturing processes and give away this knowledge to rival employers.

The drawings made for American machine shops contain much more information than is customary over here, instructions for carrying out the work being appended, together with notes as to the jigs and tools required.

Contrary to a general impression, American workmen are not dismissed for every mistake they make, but when an error occurs, steps are immediately taken to find out who is responsible, and to make such arrangements as will avoid a similar mistake in future. Inspection is more thorough than in our shops, consequently errors are quickly discovered instead of remaining unknown until a machine is put together, when the delay involved may be serious.

The American working hours of 7 a.m. to 6 p.m., with an hour for dinner, are favourably commented upon, but we feel very doubtful whether the British workman would approve of two five-hour stretches of work without a break.

Mr. Livermore concludes with a detailed description of American practice as regards apprentices. Very great care is taken in the choice of youths, and a three months' trial is customary before the agreement is signed. If during this period the boy shows insufficient interest in his work, he is advised to take up some other business more to his liking. Should the trial prove satisfactory, however, the apprentice is asked to sign an agreement for four years and to pay a small premium of about £10. Throughout his training he is looked after by a skilled man, who has charge of all apprentices. This man will visit him frequently and explain the work he is engaged upon, and will assist him in every possible way. The pupil who pays a heavy premium for the privilege of going through all departments and working or not as pleases him, is unknown in American engineering works, all apprentices being on an equal footing. Lectures are provided and libraries are often available for the use of apprentices.

The impression given by a careful perusal of this article is that, although perhaps the proportion of well-equipped and efficiently-managed works is higher in the United States, many British undertakings are fully equal, in these respects, to the most up-to-date practice to be met with across the Atlantic. Mr. Livermore does not appear to be well up in modern practice over here, hence unfavourable comparisons are made by him in some instances which are scarcely justified by facts. As illustrating this point, mention may be made of the author's advocacy of the jig in which a detail of a machine may be tooled where required without removal. Such appliances have been fully appreciated in this country for repetition work for the last 15 or 20 years.

The comfort and well-being of the workmen is, perhaps, the most important item dealt with by Mr. Livermore, and British employers will naturally ask how far it will pay them to adopt American practice in this respect. Where the product from a factory directly concerns the general public, as in the manufacture of soap or chocolate, light healthy buildings, and happy, contented workpeople form one of the most effective advertisements it is possible to produce, and even the purchasers of steam engines, or dynamos, are to a considerable extent affected by the conditions under which such machinery is turned out. A light, airy, well-arranged factory is much more likely to produce good work than are shops of the old-fashioned type, and the provision of washing and cloak room accommodation helps to attract and retain the smartest workmen, in addition to enhancing their self-respect.

We are doubtful, however, whether anything is to be gained by going beyond this point. Several firms have built houses for their employés to live in, but the British workman is not generally enamoured of occupying a house owned by his employer if other quarters are available. He likes to feel entirely independent of his employer's control or espionage outside the works, and notice to quit his home if dismissed from the factory is not always convenient.

A restaurant close outside the works where the men can obtain cheap meals at any time has been found by experience to be essential, but although the employers may provide the necessary building and equipment at a reasonable rent, the management should be in the hands of a committee of workmen, no control being attempted by the bosses.

As regards educational facilities in the form of lectures, classes, and a good technical library, these advantages are imperative for the younger employés and apprentices, but here again the workmen themselves should be encouraged to form a society or club for such purposes, no part being taken in the control by officials unless desired by a majority of the members. The initiation of such a club may have to be undertaken by the management in the first instance, but as soon as the concern is fairly started, the officials of the undertaking should, if possible, withdraw from participation in the control unless re-elected by ballot.

The American plan of considering all suggestions, for the improvement of their manufacturing plant or products, from employés is certainly worthy of more extended adoption in this country. But to ensure success, adequate payment must be made when the suggested improvement is adopted. Mr. Livermore quotes the practice of one well-known firm which undertakes to pay to the suggestor half the saving effected during the first 12 months after the improvement has been put into practice.

A SIMPLE STORY.

By INNOCENS.

THE CHIEF WHO PUBLICISED.

Now it came to pass that a certain Chief was seized of an idea. And as such seizures are uncommon and alarming, they are dangerous in the extreme. And as the Chief was under the influence (of the idea), he cried aloud and said, "Lo, I will boost this business with the biggest boost that ever began to be." For the Chief had been studying the art of alliteration with regard to advertising.

And when he had thus said he consulted his second, and said unto him, "How thinkest thou of this publicity business? Thinkest thou that we may add to our output forty and four thousand kilowatts per month by the writing of circular letters, even as they do in America?"

But the second was a Scotchman, and a man of slow mind, and knowing more of pistons than of printing, and of coal than of circulars, he answered and spake, saying "Rats!"

Wherefore the Chief slanged him, and told him to go and see why in the name of the things that are under the earth, the stokers were making such a lot of smoke, for that was all he was good for. And he himself strove mightily within himself, and evolved four letters, which he called a follow-up campaign.

And the first letter thereof did commence:—

"Dear Sir,—Doubtless you are about as surprised to receive this letter as we were to write it. Don't be alarmed. There is no animosity. We only want to tell you about our best juice at 6d. per unit, which beats all other juices, including gas-trick juices, off the face of the earth." For this was the style of the letters that are written in America.

And the second letter thereof read:—

"My dear friend,—I would like to tap you on the shoulder and ask you when you are going to wake up and realise that I wrote to you a few days ago about our JUICE—juice, I tell you! If you miss this opportunity your grey hairs will go down in sorrow to the grave."

And the Chief smiled and thought that the Americans could not do better.

And the third letter thereof read:—

"Dear James (or Charlie, or Willie, or whatever your name may be),—Why don't you listen to the tip of an old pal who never wished you any harm? *Don't you know* that you are leading a blighted existence? *Don't you know* that you are an outsider, a hanger-on, a nonentity suffered to remain suspended by the eyebrows to the fringe of civilisation? That is so long as you don't use our patent juice, generated from electric machines of unparalleled magnitude, which I keep under my personal supervision." And the Chief felt more pleased with himself than ever. But he reflected that the last letter, to be effective, must be a regular stinger and outshine everything that had gone before. Therefore he wrote:—

"You there!

"Why in thunder don't you write back to me? Don't you know I am here to do you good? Don't disregard me. Think of what my juice can do for you. An electric shave will only cost you 0·000065d. per day. Your baby's milk can be warmed for a week at the same cost as your morning paper. I assume you have a baby. I am throwing money at you. Why can't you catch it?"

And the Chief leaned back in his chair with a satisfied expression, and half thought of showing the letters unto his second. But on second thoughts he reflected that a Scotchman wouldn't see the humour of the idea. And in this the Chief had made a great mistake, for the clerk subsequently showed the letters unto the second, and he saw the humour at once.

But the Chief went forth unto a local printer, whom he desired to get on to his supply—and sayeth unto him, "Lo, print these for me, and likewise knock me together two or three pamphlets on Electricity, and I will pay thee well." And they struggled hard for many days, and after a season and half-a-season, produced a pamphlet of sorts. And the printer charged for it.

Now, therefore, the Chief issued these letters, and much notice was taken of them in the town, inasmuch as they were reprinted in full in the local newspaper, which was a very great advertisement. Moreover, the Editor did write certain things concerning them in his wittiest vein, which caused many people to smile sinfully. Yet the Chief saw not the point of the jest.

And lo, many letters were returned unto him with rude and scurrilous remarks written thereon. And the office boy snickered thereat. Yet came there no order for juice. And the Chief railed on the townsmen for a pig-headed generation. But, verily, there came unto him at last a visitor with reference to these letters, and the Chief's heart leapt for joy, and he cried, "Show ye the gentleman in." And he came in. And lo, he had a glassy eye, and dishevelled hair, and his appearance was one who seeth things in a vision. And he said, "Art thou he that wrote these letters, and didst thou verily send them unto me?"

And the Chief said, "Yes, verily, so did I. What can I do for thee?"

An the man cried, "Now, heaven be praised for that a deliverer hath been raised unto me. For many years I have feared the Lunatic Asylum, for that my father and my father's father have entered there, but I have read these, thy letters, and my mind hath stood the strain. Verily I fear nothing more under the sun. And thou, do thou go unto the Asylum in my stead, for thou art worthy."

And there came unto the Chief his manager, and did say unto him, "Thou fool, thou hast spoilt thy chance. Publicity is good. Thou mightest have reaped much benefit thereby. But why didst thou try to do it thyself? Are there not advertising specialists in England who know how to do these things without circus tricks? Go to, thou art not a babe; wherefore didst thou not see that American cribs will not work in England? Verily thou hast made thy company into a laughing stock, and we must sack thee to save our face."

And it was so. But an American firm wrote and offered him the salary of many princes, for it recognised a genius!

A Model Engineering Exhibition.—A novel and interesting exhibition is to be held at the Royal Horticultural Hall, Vincent Square, Westminster, London, S.W., from October 22nd to 26th, inclusive. The event is being organised in connection with the *Model Engineer*, and will, we understand, include a good collection of engineering models of all kinds, electrical, optical and scientific instruments, technical education apparatus, and lathes, tools and workshop appliances. Many of the models will be shown at work. Scientific lectures and demonstrations will be given each day, the subjects including colour photography, sound waves, wireless telegraphy, gyroscopes, X-rays, radium, electric welding and other interesting items.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,619. "Improvements in apparatus for supplying sand to the tracks of railways in front of the driving wheels, and especially those of electric cars." D. R. Keeports. September 30th.

21,623. "Improvements in electric striking mechanism for time-pieces." M. Moeller. September 30th. (Complete.)

21,644. "Improvements in vacuum cleaning machines driven by electrical or other power which can also be worked by hand or foot in part applicable to other purposes." C. V. Boys. September 30th.

21,646. "Improvements in storage batteries." J. C. Cook and E. Sokal. September 30th.

21,651. "Improvements in receivers for wireless telegraphy." Marconi's Wireless Telegraph Co., Ltd., and A. M. Young. September 30th.

21,670. "Improvements in and relating to the control of electric motors." Allgemeine Elektricitats Gesellschaft. (Date applied for under Patents Act, 1901, October 1st, 1906, being date of application in Germany.) September 30th. (Complete.)

21,699. "Improvements in or relating to magnetos and connections therefor in explosion engines." E. Denieport. October 1st. (Complete.)

21,702. "Improved ready means for insulating." W. V. Solomon. October 1st.

21,723. "Improvements in and relating to sub-aqueous light system." L. Dion. October 1st. (Complete.)

21,741. "Improvements in apparatus for regulating the supply of gas or electricity for heating purposes." V. V. J. Andresen. October 1st.

21,742. "Improvements in the manufacture of vulcanised bitumen." S. Paterson. October 1st.

21,761. "Improvements in electro-magnetic sparking plugs and means for distributing the operating electric current thereto." S. Griffin. October 2nd.

21,773. "Improvements in or relating to storage batteries." S. J. Watson and G. H. Smith. October 2nd.

21,802. "Luminous substitutional resistance for arc lamps, or other forms of electric lamps." A. Fletcher and F. Fletcher. October 2nd.

21,811. "Improvements in speed-limiting devices for electric motors." Benrather Machinenfabrik Actien-Gesellschaft. (Date applied for under Patents Act, 1901, October 3rd, 1906, being date of application in Germany.) October 2nd. (Complete.)

21,827. "Improvements in and relating to single-phase alternating current commutator motors." M. C. A. Latour. (Date applied for under Patents Act, 1901, October 3rd, 1906, being date of application in France.) October 3rd. (Complete.)

21,834. "Improvements in electrolytic processes and appliances." W. G. Heys. (H. Sieran, Germany.) October 3rd.

21,842. "Adjustable electric lamp-shade holder." E. G. S. Kellond. October 3rd.

21,846. "Improvements relating to pickling, plating, and other like vats, tanks or baths." G. W. Oakes. October 3rd.

21,860. "Improved method of insulating transformers and other electric apparatus." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke, G.m.b.H., Germany.) October 3rd. (Complete.)

21,861. "New or improved electric switchboard cable connector." S. Rosenbaum. (Date applied for under Patents Act, 1901, October 3rd, 1906, being date of application in Germany.) October 3rd. (Complete.)

21,862. "Armature for magneto-electric igniting apparatuses." R. Rickmann. October 3rd. (Complete.)

21,885. "Improvements in making electric accumulators." M. C. R. Liebmann. October 3rd.

21,904. "Improvements in automatic electric current breakers." A. Eckstein, A. C. Heap and D. B. Mellis. October 4th.

21,911. "Improved compounds for electric insulation, varnishes, paints and the like." J. T. Szek and C. Joly. October 4th.

21,928. "Improved globe or shade-holder for inverted incandescent and other gas lights, and for electric lights." H. G. Richardson. October 4th.

21,937. "Improvements in electrically-propelled vehicles." K. P. H. Richter and E. F. Thefs. October 4th.

21,938. "Improvements relating to electrical switches." D. K. Morris and G. A. Lister. October 4th.

21,950. "Improvements in telegraphic code appliance." W. C. Dotesio and G. H. Powell. October 4th.

21,966. "Improved adjustable holder for telephones." J. J. Chiswell. October 5th.

21,982. "Improvements in trolley heads." J. C. Drewet. October 5th. (Complete.)

21,984. "Improvements relating to telephone receivers and transmitters." J. G. Douglass. October 5th.

22,000. "Improvements in or relating to electric cranes and other electric hoists." H. Pieper. (Date applied for under Patents Act, 1901, October 6th, 1906, being date of application in Belgium.) October 5th. (Complete.)

22,028. "Improvements in or relating to the manufacture of plated or coated iron and steel sheets." J. W. Paton. October 5th.

22,035. "Improved vapour incandescence lamps." O. Imray. (Washington Licht Ges., Germany.) October 5th. (Complete.)

22,036. "Improved process of and means for manufacturing filaments for illuminating and heating purposes." W. E. Lake. (G. Michaud and E. Delasson, France.) October 5th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Barrels for Electroplating. C. Walker. 17,384. August 2nd.

Systems of Electrical Distribution in which Vapour-Electric Devices are Employed. P. H. Thomas. 19,461a. August 31st. (Date applied for under International Convention, September 1st, 1905.) (Originally included in 19,461, 1906.)

Receivers for Wireless Telegraphy. A. Artom. 19,805a. September 5th. (Date applied for under Rule 5, Patents Rules 1905, September 5th, 1906.)

Electric Storage Batteries. J. Boyle and H. Hartley. 19,945. September 7th.

Reading Machines in which Electrical Apparatus Control Phonographs and Telegraphones. E. Dragoumis. 19,956. September 7th.

Telegraphic Transmitters. C. E. Yetman. 20,115. September 10th.

Switches for Use in Electric Circuits. F. Broadbent. 20,369. September 13th.

Vaporisers for Incandescent Vapour Lamps. A. Meissner and J. Danischevski. 21,243a. September 25th. (Date applied for under Rule 5, Patents Rules 1905, September 25th, 1906.)

Bases of Electrical Fittings. H. Hirst. 22,091. October 6th.

Manufacture of Metallic Incandescing Bodies for Electric Lamps. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 24,236. October 30th.

Magneto-Electric Generators. J. A. Williams. 25,692. November 13th.

Fuse Heads for Electric Blasting. F. Render. 25,685. November 14th.

Electrolytic Manufacture of Metal Wire, Strip, or the like. S. O. Cowper-Coles. 27,099. November 28th.

Systems of Electric Motor Control. British Thomson-Houston Co. (General Electric Co., United States.) 18,490. August 17th.

Plates and Connectors for Electric Batteries. H. Sefton-Jones. (Decker Electrical Manufacturing Co.) 19,951b. September 7th. (Date applied for under Rule 5, Patents Rules 1905, September 7th, 1906.)

Electric Burglar Alarm Systems. E. A. Prevette. 20,182. September 11th.

Electric Insulator Stalks. A. G. Bloxam. (J. Goffin.) 20,234. September 11th.

Electric Incandescence Lamps Suitable for Theatrical, Decorative and other Purposes. W. J. Crawshaw and R. Affleck. 20,294. September 12th.

Control of Electric Motors. British Thomson-Houston Co. (General Electric Co., United States.) 20,464. September 14th.

Dynamos for Ignition Purposes on Motor-Cars. F. A. Fitch. 21,703. October 2nd.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co., United States.) 22,221. October 8th.

Interlocking Mechanism for Enclosed Electrical Switches with Removable Contact Plugs. H. W. Cox. 22,700., October 13th.

Electric Heaters. H. Leitner. 22,808. October 15th.

Devices for Controlling Electric Circuits, Especially Applicable to the Control of Electric Motors. British Thomson-Houston Co. (General Electric Co., United States.) 23,011. October 17th.

Systems of Electric Distribution. British Thomson-Houston Co. (General Electric Co., United States.) 23,107. October 18th.

Dynamo-Electric Machines, more Especially Applicable to the Regulation of Said Machines. British Thomson-Houston Co. (General Electric Co., United States.) 23,563. October 23rd.

Signal Systems for Railways and the like. British Thomson-Houston Co. (General Electric Co., United States.) 23,686. October 24th.

Electrical Time Switches. R. F. Venner and R. C. Griesbach. 23,742. October 25th.

Starting Devices for Electric Motors. M. Kallmann. 24,995. November 6th.

Method of Electrical Regulation. J. Bijur. 25,289. November 9th.

Tremblers of Induction Coils. Electric Ignition Co. and F. H. Hall. 25,770. November 15th.

Intercommunication Telephones and Switches Therefor. F. G. Bell. 28,922. December 18th.

Electric Contact Devices. A. A. Kent. 29,476. December 24th. (Date applied for under International Convention, December 26th, 1905.)

Electric Furnaces. S. Z. de Ferranti. 13,965. June 18th.

Motor-Operated Electric Switches. British Thomson-Houston Co. (General Electric Co., United States.) 15,835. July 12th.

Method of Operation with Lead-Peroxide-Zinc Storage Batteries. R. Ziegenberg. 20,327. September 12th.

Systems of Operating Electric Motors for Braking Purposes. British Thomson-Houston Co. (General Electric Co., United States.) 21,004. September 21st.

Apparatus for the Manufacture of Iron Tubes by Electro-Deposition. S. O. Cowper-Coles. 21,081. September 22nd.

Electrical Switch and like Gear. W. Roberts. (J. Roberts.) 21,091. (September 22nd.

Means of Ventilating Dynamo-Electric Machines, Particularly Petrol-Electric Automobiles. W. A. Stevens. 21,129. September 24th.

Accumulator Boxes and other Receptacles. J. Stone & Co. and E. M. Preston. 21,252. September 25th.

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Electrical Apparatus for Signalling on Railways. A. W. McMaugh and R. Welch. 708. January 10th.

Manufacture of Tubular Articles by Electrolysis. A. Uzac. 5,036. March 1st. (Date applied for under International Convention, March 3rd, 1906.)

Means for Extracting Pieces of Iron and other Magnetic Substances from Raw Textile and other Light Materials. G. Whittaker and J. R. Ashworth. 9,718. April 26th.

Electric Lighting of Surgical Specula and the like. S. Kaplan and E. Batault. 10,993. May 11th. (Date applied for under International Convention, May 14th, 1906.)

Contact Spring for Electrical Apparatus. Deutsche Telephonwerke Ges. 12,532. May 30th. (Date applied for under International Convention, May 31st, 1906.)

Electricity Meters. Compagnie de Construction Electrique. 17,894. August 6th. (Date applied for under International Convention, November 10th, 1906.)

Caps for Electric Lamps of Variable Luminosity. F. Harrison. 28. January 1st.

Electric Measuring Instruments. F. H. Nalder and Nalder Bros. and Thompson. 725. January 10th.

Electric Door Contact for Alarm Bells and the like. F. Zinth. 2,019. January 26th.

Electrically-Operated Vibrating Plate Sounders. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 3,778. February 15th.

Manufacture of Incandescent Lamps with Wolfram Incandescent Bodies. Consortium für Elektrochemische Industrie Ges. 3,938. February 16th. (Date applied for under International Convention, February 21st, 1906.)

Electric Switches. Electric & Ordnance Accessories Co., R. F. Hall and J. R. Garner. 4,292. February 21st.

Magnetic Compasses. A. Laube. 4,340. February 21st.

Apparatus for Controlling Electric Currents. E. de Bremaecker. 4,578 February 25th.

Signalling by Electro-Magnetic Waves. R. A. Fessenden. 4,712. February 26th.

Wireless Telegraphy. V. Poulsen. 4,799. February 27th.

Receiving Apparatus for Wireless Telegraphy. G. W. Pierce. 5,951. March 5th. (Date applied for under International Convention, March 16th, 1906.)

Electric Alarm Thermometer. W. Walther. 5,999. March 12th. (Date applied for under International Conventional, November 12th, 1906.)

Filaments for Incandescent Electric Lamps. H. H. Lake. (Parker Clark Electric Co.) 7,637. March 30th.

Method of Telegraphically Transmitting Photographs and the like and System Therefor. A. Korn. 8,727. April 15th.

Magnet Boxes and Armatures of Magnets Therein. C. O. Lanning. 10,518 May 6th.

Electric Circuit-Breaker. G. O. Larsson. 13,278. June 7th. (Date applied for under International Convention, June 7th, 1906.)

Controlling Switches for Electric Trains. Siemens Schuckertwerke Ges. 16,582. July 19th. (Date applied for under International Convention, July 28th, 1906.)